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[San Francisco] BULLETIN No. 96 [September, 1925

CALIFORNIA MINERAL PRODUCTION FOR 1924

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By
WALTER W. BRADLEY

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LETTER OF TRANSMITTAL.

September, 1925.

To His Excellency, The Honorable Friend Wm. Richardson,
Governor of the State of California.

Sir: I have the honor to herewith transmit Bulletin No. 96 of the State Mining Bureau, being the annual report of the statistics of the mineral production of California.

The remarkable variety, total valuation, and wide distribution of many of our minerals revealed herein show California's importance as a producer of commercial minerals among the states of the Union.

Respectfully submitted.

Lloyd L. Root,
State Mineralogist.

INTRODUCTION.

It is the endeavor of the staff of the State Mining Bureau, in these annual reports of the mineral industries of California, to so compile the statistics of production that they will be of actual use to producers and to those interested in the utilization of the mineral products of our state, while at the same time keeping the individual's data confidential. In addition to the mere figures of output, we have included descriptions of the uses and characteristics of many of the materials, as well as a brief mention of their occurrences.

The compilation of accurate and dependable figures is an extremely difficult undertaking, and the State Mineralogist takes the opportunity of here expressing his appreciation of the cooperation of the producers in making this work possible. A fuller appreciation of the value of early responses to the requests sent out in January will result in earlier completion of the manuscript. Statistics lose much of their value if their publication is unnecessarily delayed.

Some of the data relative to properties and uses of many of the minerals herein described are repeated from preceding reports, as it is intended that this annual statistical bulletin shall be somewhat of a compendium of information on California's commercial minerals and their utilization.

LLOYD L. ROOT,
State Mineralogist.

MINERAL INDUSTRY, CALIFORNIA, 1924.

DATA COMPILED FROM DIRECT RETURNS FROM PRODUCERS IN ANSWER TO INQUIRIES SENT OUT BY THE CALIFORNIA STATE MINING BUREAU, FERRY BUILDING, SAN FRANCISCO, CALIFORNIA.

CHAPTER ONE.

The total value of the mineral output of California for the year 1924 was $374,620,789 being an increase of $30,596,111 over the 1923 total of $344,024,678. There were sixty different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all of the fifty-eight counties of the state contributed to the list.

As revealed by the data following herein, the salient features of 1924 compared with the preceding year were: The increased value of the petroleum yield, although there was a material decrease in quantity; decrease in cement value owing to lower prices, although increased amounts were manufactured; increases in copper, quicksilver, tungsten, granite, marble, miscellaneous stone, limestone, mineral water, potash, and salt; and decreases in natural gas, gold, silver, platinum, brick, magnesite, pottery clay, gypsum, pyrites and borates. The net result was an increase in the grand total of all groups of nearly thirty-one million dollars, as stated above. Petroleum accounted for an increase of $31,921,565 in total value in spite of a decrease of approximately 34,000,000 barrels in quantity.

Of the metals: copper increased from 28,346,860 pounds worth $4,166,989 to 52,089,349 pounds worth $6,823,704; quicksilver from 5458 flasks and $332,851 to 7948 flasks and $543,080; and tungsten from 34 tons and $19,126 to 781 tons and $446,009. Gold decreased slightly from $13,379,013 to $13,150,175, in spite of which, as for several years past, California continued to account for approximately 30% of the gold output of the United States. Silver decreased in value from $2,918,743 to $2,381,952, owing to a lower average price.

Of the structural group: cement advanced in quantity from 10,825,405 barrels to 11,655,131 barrels, but due to foreign importations duty free, the price dropped, resulting in a decrease of total value from $25,999,203 to $23,225,850; granite increased from $760,081 to $1,211,046 in value, due to certain large building contracts, notably the Los Angeles County Building; brick and hollow building blocks or tile decreased in total value from $9,738,082 to $9,137,908 owing mainly to a decrease in common brick. Lime and magnesite also registered decreases.

Of the 'industrial' group, as is usually the case, there were a number of fluctuations, the more important increases in value being shown by mineral water and limestone, and decreases in value by diatomaceous earth, pottery clay, gypsum, pyrites and talc. Of the salines, borates and soda showed decreases, while common salt, potash and magnesium salts advanced in quantity and value.

The figures of the State Mining Bureau are made up from reports received direct from the producers of the various minerals. Care is exercised in avoiding duplication, and any error is likely to be on the side of under- rather than over-estimation.

California yields commercially a greater number and variety of mineral products than any state in the United States, and probably more than any other equal area elsewhere of the earth. The total annual value of her output is surpassed by not more than four or five others, and those usually the great coal states of east of the Mississippi. California was for many years the sole domestic source of borax, chromite and magnesite and in which we still lead. We lead all other states in the production of gold, quicksilver, and platinum; and have alternated in the lead with Colorado in tungsten, and with Oklahoma in petroleum.

The above noted total value of California's mineral industries for 1924 exceeds by more than six million dollars, the estimate of the State Department of Agriculture for the farm values of California's agricultural production in 1924 which was placed at $368,427,000.[1]

The economic importance of the mineral industries throughout the United States as a whole is evidenced by a statement[2] recently issued by the U. S. Department of Commerce concerning the freight handled by the railroads of the country, the products of mines representing 51.33 per cent of the whole. The various industries are represented as follows:

Industry		Freight per cent
Agricultural products		10.63
Animals and products		2.23
Forest products		9.64
Manufactures and miscellaneous		26.17
Mines—		
Anthracite coal	5.68	
Bituminous coal	28.45	
Iron ore	4.23	
Clay, sand, gravel, stone	8.67	
All other mineral products	4.30	
		51.33
Total		100.00

[1]Kaufman, E. E., Agricultural statistician, Cal. Co-op. Crop Reporting Section, State Dept. of Agri.: Sacramento *Bee*, Jan. 10, 1925.
[2]Eng. & Min. Jour.-Press, Aug. 22, 1925, p. 304.

By Substances.

The following table shows the comparative yield of mineral substances of California for 1923 and 1924, as compiled from the returns received at the State Mining Bureau, San Francisco, in answer to inquiries sent to producers:

Substance	1923		1924		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Asbestos	20 tons	$200	70 tons	$4,750	$4,550+
Barytes	2,925 tons	16,058			16,058—
Bituminous rock	2,945 tons	11,780	6,040 tons	14,922	3,142+
Borates	62,667 tons	1,893,798	52,070 tons	1,599,149	294,649—
Brick and hollow tile		9,738,082		9,137,908	600,174—
Cement	10,825,405 bbls.	25,999,203	11,655,131 bbls.	23,225,850	2,773,352—
Chromite	84 tons	1,658	350 tons	6,700	5,042+
Clay (pottery)	376,863 tons	697,841	417,928 tons	651,857	45,984—
Coal	1,010 tons	5,090	1,425 tons	8,800	3,710+
Copper	28,246,860 lbs.	4,166,989	52,089,349 lbs.	6,823,704	2,656,715+
Dolomite	69,519 tons	142,615	28,843 tons	71,271	71,344—
Feldspar	11,100 tons	81,800	9,055 tons	68,112	13,688—
Fuller's earth	3,650 tons	55,125	5,290 tons	67,295	12,170+
Gems		13,220		4,800	8,420—
Gold		13,379,013		13,150,175	228,838—
Granite		760,081		1,211,046	450,965+
Gypsum	86,410 tons	289,136	25,569 tons	53,210	235,926—
Iron ore	3,102 tons	18,665	*	*	*
Lead	9,934,522 lbs.	695,416	4,984,387 lbs.	398,751	296,665—
Lime	70,894 tons	788,834	62,029 tons	703,355	85,479—
Limestone	143,266 tons	348,464	219,476 tons	582,660	234,196+
Lithia			109 tons	2,269	2,269+
Magnesite	73,963 tons	946,643	67,236 tons	900,183	46,460—
Magnesium salts	3,662 tons	116,031	4,823 tons	145,883	29,852+
Manganese ore	690 tons	10,620	1,115 tons	25,785	15,165+
Marble	28,015 cu. ft.	124,919	[a]61,579 cu. ft.	140,253	15,334+
Mineral paint	1,049 tons	11,773	532 tons	5,234	6,539—
Mineral water	5,487,276 gals.	616,919	8,159,211 gals.	818,726	201,807+
Natural gas	240,405,397 M cu. ft.	15,661,433	209,921,596 M cu. ft.	15,153,140	508,293—
Onyx and travertine	14,220 cu. ft.	2,510	[b]		+
Petroleum	262,875,690 bbls.	242,731,309	228,933,471 bbls.	274,652,874	31,921,565+
Platinum	602 fine oz.	78,546	273 fine oz.	36,452	42,094—
Potash	29,597 tons	709,836	33,107 tons	747,407	37,571+
Pumice and volcanic ash	2,936 tons	16,309	4,919 tons	33,404	17,095+
Pyrites	148,004 tons	555,308	124,214 tons	517,835	37,473—
Quicksilver	5,458 flasks	332,851	7,948 flasks	543,080	210,229+
Salt	275,979 tons	1,130,670	318,800 tons	1,159,137	28,467+
Sandstone	7,000 cu. ft.	13,000	6,700 cu. ft.	3,600	9,400—
Silica (sand and quartz)	7,964 tons	30,420	6,808 tons	35,006	4,586+
Silver	3,559,443 fine oz.	2,918,743	3,555,153 fine oz.	2,381,952	536,791—
Soapstone and talc	17,439 tons	252,661	16,179 tons	242,770	9,891—
Soda	34,885 tons	764,284	32,536 tons	711,796	52,488—
Stone, miscellaneous [c]		15,395,652		15,966,380	570,728+
Tungsten concentrates	34 tons	19,126	781 tons	446,009	426,883+
Zinc			3,060,000 lbs.	198,900	198,900+
Unapportioned		[d]2,482,047		[e]1,968,399	513,648—
Total values		$344,024,678		$374,620,789	
Net increase					$30,596,111+

* See under 'unapportioned.'

[a] Includes onyx and travertine.

[b] Combined with marble.

[c] Includes macadam, ballast, rubble, riprap, paving blocks, sand, gravel, and grinding-mill pebbles.

[d] Includes diatomaceous earth, calcium chloride, shale oil, sillimanite-andalusite, and sulphur.

[e] Includes calcium chloride, diatomaceous earth, iron ore, shale oil, sillimanite-andalusite, sulphur, aluminum sulphate, glauber salt, potash alum, mica schist, radio galena crystals, arsenic.

By Counties.

The following table shows the comparative value of the mineral production of the various counties in the state, for the years 1923 and 1924:

County	1923	1924	County	1923	1924
Alameda	$2 487,035	$2,634,645	Placer	$494,513	$492,180
Alpine		2,552	Plumas	3,784,262	3,876,105
Amador	1,955,874	2,938,865	Riverside	7,093,853	5,508,244
Butte	841,948	641,750	Sacramento	2,436,015	2,196,210
Calaveras	1,498,119	1,572,419	San Benito	2,277,903	2,144,603
Colusa	75,000	77,267	San Bernardino	13,777,253	12,642,431
Contra Costa	2,672,944	2,348,090	San Diego	821,796	1,013,119
Del Norte	34,027	722,265	San Francisco	117,341	150,258
El Dorado	216,065	395,572	San Joaquin	811,229	602,500
Fresno	4,883,331	12,547,798	San Luis Obispo	145,219	317,779
Glenn	113,282	41,550	San Mateo	329,816	302,171
Humboldt	434,706	485,478	Santa Barbara	5,005,872	5,159,740
Imperial	264,733	139,908	Santa Clara	1,320,393	1,150,401
Inyo	2,845,581	2,110,075	Santa Cruz	4,225,905	4,339,233
Kern	41,812,415	74,164,451	Shasta	1,563,387	4,754,664
Kings	1,555	725	Sierra	886,610	812,476
Lake	101,038	96,396	Siskiyou	181,011	140,787
Lassen	7,840	37,908	Solano	3,376,885	3,089,475
Los Angeles	174,367,459	168,420,709	Sonoma	227,312	172,051
Madera	518,035	955,469	Stanislaus	445,515	345,138
Marin	688,851	527,231	Sutter	97	97
Mariposa	170,911	234,707	Tehama	6,216	34,454
Mendocino	53,410	60,768	Trinity	677,174	509,344
Merced	235,630	87,603	Tulare	466,559	498,674
Modoc	8,397	1,300	Tuolumne	670,362	629,156
Mono	92,791	126,691	Ventura	4,679,684	6,089,394
Monterey	222,022	286,490	Yolo	16,957	15,800
Napa	351,592	359,265	Yuba	3,391,129	2,189,881
Nevada	2,370,770	2,945,267			
Orange	45,468,989	40,481,210	Total values	$344,024,678	$374,620,789

Total Mineral Production of California, by Years.

The following tabulation gives the total value of mineral production of California by years since 1887, in which year compilation of such data by the State Mining Bureau began. At the side of these figures the writer has placed the values of the most important metal and non-metal items—gold and petroleum.

In the same period copper made an important growth beginning with 1897 following the entry of the Shasta County mines, and more recently Plumas County. Cement increased rapidly from 1902, while crushed rock, sand and gravel as a group parallels the cement increase. Quicksilver has been up and down. Mineral water and salt have always been important items, but the values fluctuate. Borax has increased materially since 1896. War-time increases, 1915–1918, were shown by chromite, copper, lead, magnesite, manganese, silver, tungsten and zinc. Most of these, except silver, have since declined; with structural materials and copper increasing in 1920-1924, also lead and magnesite in 1923.

Total Mineral Production of California by Years, Since 1887.

Year	Total value of all minerals	Gold, value	Petroleum, value
1887	$19,785,868	$13,588,611	$1,357,144
1888	19,469,320	12,750,000	1,380,666
1889	16,681,731	11,212,913	368,048
1890	18,039,666	12,309,793	384,200
1891	18,872,413	12,728,869	401,264
1892	18,300,168	12,571,900	561,333
1893	18,811,261	12,422,811	608,092
1894	20,203,294	13,923,281	1,064,521
1895	22,844,663	15,334,317	1,000,235
1896	24,291,398	17,181,562	1,180,793
1897	25,142,441	15,871,401	1,918,269
1898	27,289,079	15,906,478	2,376,420
1899	29,313,460	15,336,031	2,660,793
1900	32,622,945	15,863,355	4,152,928
1901	34,355,981	16,989,044	2,961,102
1902	35,069,105	16,910,320	4,692,189
1903	37,759,040	16,471,264	7,313,271
1904	43,778,348	19,109,600	8,317,809
1905	43,069,227	19,197,043	9,007,820
1906	46,776,085	18,732,452	9,238,020
1907	55,697,949	16,727,928	16,783,943
1908	66,363,198	18,761,559	26,566,181
1909	82,972,209	20,237,870	32,398,187
1910	88,419,079	19,715,440	37,689,542
1911	87,497,879	19,738,908	40,552,088
1912	88,972,385	19,713,478	41,868,344
1913	98,644 639	20,406,958	48,578,014
1914	93,314,773	20,653,496	47,487,109
1915	96,663,369	22,442,296	43,503,837
1916	127,901,610	21,410,741	57,421,334
1917	161,202,962	20,087,504	86,976,209
1918	199,753,837	16,529,162	127,459,221
1919	195,830,002	16,695,955	142,610,563
1920	242,099,667	14,311,043	178,394,937
1921	268,157,472	15,704,822	203,138,225
1922	245,183,826	14,670,346	173,381,265
1923	344,024,678	13,379,013	242,731,309
1924	374,620,789	13,150,175	274,652,874
Total values	$3,470,395,816	$628,747,742	$1,883,138,099

CHAPTER TWO.

FUELS.

Among the most important mineral products of California are its fuels. This subdivision includes coal, natural gas, and petroleum, the combined values of which made up 77% of the state's entire mineral output for the year 1924.

There are deposits of peat known in several localities in California, small amounts of which are used as a fertilizer, and in stock-food preparations, but none has yet been recorded as utilized for fuel.

Comparison of values during 1923 and 1924 is shown in the following table:

	1923		1924		Increase+ Decrease—
	Amount	Value	Amount	Value	Value
Coal	1,010 tons	$5,090	1,425 tons	$8,800	$3,710+
Natural gas	240,405,397 M cu.ft.	15,661,433	209,921,596 M cu.ft.	15,153,140	508,293—
Petroleum	262,875,690 bbls.	242,731,309	228,933,471 bbls.	274,652,874	31,921,565+
Total value		$258,397,832		$289,814,814	
Net increase					$31,416,982+

COAL.

Bibliography: State Mineralogist Reports VII, XII–XV (inc.), XVII, XIX–XXI (inc.). U. S. Geol. Surv., Bulletins 285, 316, 431, 471, 581; An. Rpt. 22, Pt. III.

Coal production in California in 1924 totaled only 1425 tons valued at $8,800, being credited to Amador, Mendocino, Riverside, San Benito, Shasta, and Siskiyou counties. Only a small part of it was marketed, as it was mainly consumed for local camp purposes and for power and forge use in development work on the deposits.

Total Coal Production of California.

The very considerable output of coal in the years previous to 1883 was almost entirely from the Mount Diablo district, Contra Costa County. Later the Tesla mine in Corral Hollow, Alameda County, was an important producer for a few years. Stone Canyon, Monterey County, was also an important producer for a short time, and there has been some coal shipped from properties in Amador, Fresno, Orange, Riverside and Siskiyou counties. The following tabulation gives the annual tonnages and values, according to available records:

Coal Output and Value by Years.

Year	Tons	Value	Year	Tons	Value
1861	6,620	$38,065	1894	59,887	$139,862
1862	23,400	134,550	1895	79,858	193,790
1863	43,200	248,400	1896	70,649	161,335
1864	50,700	291,525	1897	87,449	196,255
1865	60,530	348,048	1898	143,045	337,475
1866	84,020	483,115	1899	160,941	420,109
1867	124,690	716,968	1900	176,956	535,531
1868	143,676	826,137	1901	150,724	401,772
1869	157,234	904,096	1902	88,460	248,622
1870	141,890	815,868	1903	93,026	265,383
1871	152,493	876,835	1904	79,062	376,494
1872	190,859	1,097,439	1905	46,500	144,500
1873	186,611	1,073,013	1906	24,850	61,600
1874	215,352	1,238,274	1907	23,734	55,849
1875	166,638	958,169	1908	18,496	55,503
1876	128,049	736,282	1909	49,389	216,913
1877	107,789	619,787	1910	11,033	23,484
1878	134,237	771,863	1911	11,047	18,297
1879	147,879	850,304	1912	14,484	39,092
1880	236,950	1,362,463	1913	25,198	85,809
1881	140,000	805,000	1914	11,859	28,806
1882	112,592	647,404	1915	10,299	26,662
1883	76,162	380,810	1916	4,037	7,030
1884	77,485	309,950	1917	3,527	7,691
1885	71,615	286,460	1918	6,343	16,149
1886	100,000	300,000	1919	2,983	8,203
1887	50,000	150,000	1920	2,078	5,450
1888	95,000	380,000	1921	12,467	63,578
1889	121,280	288,232	1922	27,020	135,100
1890	110,711	283,019	1923	1,010	5,090
1891	93,301	204,902	1924	1,425	8,800
1892	85,178	209,711			
1893	72,603	167,555	Totals	5,206,580	$23,094,478

The tonnages in the above table for the years 1861–1886 (incl.) are taken from the U. S. Geological Survey, "Mineral Resources of the U. S., 1910," p. 107. The values assigned for the years previous to 1883 are those given by W. A. Goodyear (Mineral Res., 1882, pp. 93–94), being an average of $5.75 per ton. From 1887 to date the figures are those of the California State Mining Bureau.

NATURAL GAS.

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV. Bulletins 3, 16, 19, 69, 73, 89. Monthly Summary, Oil & Gas Supervisor, Dec. 1919; Aug. 1922; Mar. 1923.

Statistics on the production of natural gas in California are in a considerable degree difficult to arrive at, as much of it that is utilized directly at the wells for heating, lighting, and driving gas engines is not measured. Hence, it is necessary to approximate the output of many of the operators in the oil fields, estimated on the number of lights, and on the number and horsepower of gas engines and steam boilers thus operated. The figures here given are for gas utilized locally and also that sold for distribution to consumers; and we consider are not over-estimated, particularly in the six oil-producing counties. It must be remembered that several of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any considerable distance may not always be profitable, nor is it often possible to have pipe-line facilities available to handle the gas accompanying the early gas production in newly developed fields. Wherever

feasible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam driven plants.

The most notable gas developments in California in recent years have been in the Elk Hills and Buena Vista Hills in Kern County, northeast of the Midway district, and in the new oil fields in the Los Angeles basin, Los Angeles and Orange counties. The yield of natural gas in the last-named district increased many fold in 1923 over that of 1922, the amount actually utilized being six times that of the preceding year. Lack of sufficient pipe-lines and other facilities to handle such an enormous increase made it impossible to prevent large quantities going to waste into the air.

Production and Value.

There is rather a wide variation in prices quoted for natural gas because a considerable part is used directly in the field for driving gas engines and firing boilers, and is therefore not measured nor sold. Such companies as have placed a valuation on the gas that was thus used in 1924 gave from 3¢–25¢ per 1000 cubic feet, at the well. From the totals shown in the tabulation following herein, the average value for all fields in 1924 works out at approximately 7.2¢. Approximately 7000 cubic feet of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4000 cu. ft. per 24 hr. are consumed by a 25-h.p. engine and 63,700 cu. ft. per day for heating a 70-h.p. steam boiler, which figures have been utilized in compiling this report, in those cases where gas was not metered.

Natural Gas 'Consumed,' or Utilized for Fuel, 1924.

County	M cu. ft.	Value
Fresno	1,436,708	$102,286
Kern	47,881,308	2,522,551
Kings	1,480	725
Los Angeles	122,838,521	9,191,395
Orange	29,812,139	2,397,813
Santa Barbara	1,643,355	158,836
Tulare	1,080	540
Ventura	5,995,760	633,352
Butte, Humboldt, Lake, Mendocino, Sacramento, San Joaquin, San Luis Obispo, Sutter, Yuba*	317,245	145,642
Totals	209,921,596	$15,153,140

*Combined to conceal output of a single operator in each.

The above totals for 1924 compare with 240,405,397 M cu. ft., valued at $15,661,433 in 1923 which year was nearly 2½ times the quantity and more than double the value of 1922.

The 1923 total of quantity was approximately one-half of the previously recorded total for California for the years 1888–1922 inclusive; and the 1923 total of value equaled 41% of the total value for the same period. This was due to remarkable increases in the Los Angeles and Orange County fields. In 1924, the quantities of natural gas utilized in those two counties decreased; Kern and Ventura counties showed increases.

The compiled figures for 1924 received from two of the larger agencies handling natural gas and natural-gas gasoline, total somewhat higher than the aggregate of the data received direct by the State Mining Bureau from the separate plants and operators. Assuming that our list of operators may have lacked some names, from whom we there-

by lacked returns, we have taken an average of these several sets of figures as the basis for the present report. Compared with 1923, there was a decrease in Los Angeles County in the amount of gas consumed, owing to the decline of oil production in the older of the new fields.

There was an increase in gasoline recovered from natural gas because in the newest two fields (Rosecrans and Dominguez) there was a large flow of gas but no pipe line facilities for conveying it to the consuming centers. In this case, the gasoline was 'squeezed' out of a portion and the dry gas blown into the air unconsumed.

Natural Gas Production in California, Since 1888.

The production of natural gas in California by years since 1888 is given in the following table. The first economic use of natural gas in California was from the famous Court House well at Stockton, bored in 1854–1858. Beginning about 1883 and for several succeeding years, a number of gas wells were brought in around Stockton. Natural gas was known in a number of other localities, and occasionally utilized in a small way, notably at Kelseyville in Lake County, and in Humboldt County near Petrolia and Eureka, but there are no available authentic records of amounts or values previous to the year 1888. The most important developments in the commercial production of natural gas have been coincident with developments in the oil fields, by utilizing the casing-head gas as well as that from dry-gas wells.

Year	M cubic feet	Value	Year	M cubic feet	Value
1888	[a]12,000	$10,000	1907	169,991	$114,759
1889	[a]14,500	12,680	1908	842,883	474,584
1890	[a]41,250	33,000	1909	1,148,467	616,932
1891	[a]39,000	30,000	1910	10,579,933	1,676,367
1892	[a]75,000	55,000	1911	[a]5,000,000	491,859
1893	[a]84,000	68,500	1912	[a]12,600,000	940,076
1894	[a] [b]85,080	79,072	1913	14,210,836	1,053,292
1895	[a] [b]110,800	112,000	1914	16,529,963	1,049,470
1896	[a] [b]131,100	111,457	1915	21,992,892	1,706,480
1897	[a]71,300	62,657	1916	28,134,365	2,871,751
1898	[a]111,165	74,424	1917	44,343,020	2,964,922
1899	115,110	95,000	1918	46,373,052	3,289,524
1900	40,566	34,578	1919	52,173,503	4,041,217
1901	120,800	92,034	1920	58,567,772	3,898,286
1902	120,968	99,443	1921	67,043,797	4,704,678
1903	120,134	75,237	1922	103,628,027	6,990,030
1904	144,437	91,035	1923	240,405,397	15,661,433
1905	148,345	102,479	1924	209,921,596	15,153,140
1906	168,175	$109,489			
			Totals	935,419,224	$69,046,885

[a]Quantity, in part, estimated, where values only were reported.
[b]Includes natural CO_2 from a mine in Santa Clara County.

Gasoline From Natural Gas.

More or less gas usually accompanies the petroleum in the oil fields, and such gas carries varying amounts of gasoline. A total of 137 plants were in operation in 1924 recovering gasoline by compression or absorption from this 'casing-head' gas. After the gasoline is extracted the remaining 'dry gas' so far as possible is taken into pipe lines, by which it is distributed to consumers, both domestic and commercial.

In the Midway field, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to transmission through the gas pipe lines. Some concerns market casing-head gasoline separately while others turn it into the oil pipe lines, thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery, where it is later regained. A total of 228,781,000 gallons of casing-head gasoline valued at $22,269,955 from all fields was reported by 82 operators (137 plants), as made during 1924. This compares with 156,263,015 gallons and $13,197,578 by 87 operators in 1923. It was distributed by counties, as follows:

Natural Gas Gasoline Recovered, 1924.

County	No. Plants	Gallons	Value
Fresno	2	590,370	$53,431
Kern	33	43,045,434	4,895,828
Los Angeles	65	124,883,000	11,575,000
Orange	26	47,166,640	4,468,627
Santa Barbara	4	7,023,891	702,390
Ventura	7	6,072,465	574,679
Totals	137	228,781,800	$22,269,955

The usual recoveries of gasoline from natural gas vary from ½ gal. to 3 gal. per 1000 cu. ft. of gas handled, the average being about 1 gal. per 1000 cu. ft.

PETROLEUM.

Bibliography: State Mineralogist Reports IV, VII, X, XII, XIII. Bulletins 3, 11, 16, 19, 31, 32, 63, 69, 73, 82, 84, 89. Reports of Oil and Gas Supervisor 1915 to date (issued in monthly chapters since April, 1919). U. S. Geol. Surv., Bulletins 213, 285, 309, 317, 321, 322, 340, 357, 398, 406, 431, 471, 451, 581, 603, 621, 623, 653, 691; Prof. Papers, 116, 117. "American Petroleum: Supply and Demand": Amer. Petr. Inst., 1925.

The crude oil production of California for 1924 amounted to a total of 228,933,471 barrels of clean oil, valued at $274,652,874 at the well. This total of quantity is compiled from the monthly production reports filed by the operators with the State Oil and Gas Supervisor, to which have been added figures for the output of a number of small operators in the Los Angeles city field not under the jurisdiction of the Supervisor.

The question of the value of the crude oil yield, at the well, is a difficult one to settle with exactitude, principally because a large part of the output is not sold until after refining. The large refiners are also large producers of crude oil which they send direct from well to plant, hence much of the crude is not sold as such. The values used in the statistical reports of the State Mining Bureau since 1914 have been derived from averages of actual sales of crude oil of all grades in each field of the state, and these averages applied to the total yield of the respective fields. This we feel is a safer measure of commercial values than market quotations, because quotations do not always mean sales.

Features of 1924.

The noteworthy features of the year 1924 in the oil industry of California were the decrease in gusher production in the new fields in the

Los Angeles Basin, and the increase in the market value per barrel for crudes. Quantities in Los Angeles and Orange counties decreased, while Fresno, Kern, and Ventura registered material increases. In Fresno and Kern counties, much of the shut-in production was again opened up and drilling activity also resumed. There were two increases in 1924 in prices quoted for crude oil at the well announced by the marketing companies: one, February 5 affecting all grades; and the other, September 24 for high-gravity crude in the new Rosecrans field.

Estimating in January the output of the year just closed, the State Oil and Gas Supervisor[1] presented the following observations:

"The production of oil in California in 1924 was 230,045,000 barrels, according to statistics of the American Petroleum Institute, including estimates for the month of December. This is 33,683,895 barrels less than was produced in 1923.

"An analysis of the increases and decreases in the various parts of the State is of value in showing the effect of decline just following the flush period of some fields, partly offset by the development of new fields and the resumption of closed-in production in some of the older fields.

"The greatest declines were in the Santa Fe Springs, Huntington Beach and Long Beach fields, which produced 78,964,000 barrels less in 1924 than in 1923, distributed as follows: Santa Fe Springs, 53,385,000; Huntington Beach, 16,863,000; Long Beach, 8,716,000.

"The decline was partly offset by an increase of 45,283,000 barrels in other fields, the fields of the San Joaquin Valley producing 19,677,000 barrels more in 1924, both from new wells and from wells shut down during all or part of 1923; Torrance and the new fields Dominguez and Rosecrans contributing increased production as follows: Torrance 14,377,000 barrels, Dominguez 6,623,000 barrels, Rosecrans 620,000 barrels; the Coyote Hills field, practically shut down during part of 1923, contributing 3,206,000 barrels more in 1924 than in 1923; and miscellaneous 780,000 barrels."

Outlook for 1925.

It is difficult to predict, as yet, for 1925. Lacking the opening up of any new field, it appears thus far that the output for the current year will probably be less in total quantity than the year 1924, due largely to the decline in the Los Angeles Basin fields.

Production Figures.

The following table gives the production and value by counties for 1924, compared with the 1923 figures:

TABLE A.

Production and Value of Crude Oil, by Counties.

County	1923		1924	
	Barrels	Value	Barrels	Value
Fresno	5,061,542	$3,593,695	10,156,405	$14,801,743
Kern	45,952,794	37,629,300	61,175,405	69,572,934
Los Angeles	158,665,019	154,063,733	119,027,428	147,474,953
Orange	46,474,921	40,897,930	31,661,283	37,455,298
San Luis Obispo	32,988	19,793	31,222	30,972
Santa Barbara	3,061,947	2,394,433	2,905,181	3,009,768
Santa Clara			14,117	20,481
Ventura	3,610,794	4,109,084	3,958,010	5,279,985
San Mateo and Santa Clara[a]	15,685	23,341		
San Bernardino and San Mateo[b]			4,120	6,740
Totals	262,875,690	$242,731,309	228,933,471	$274,652,874

[a]Combined to conceal output of a single operator in San Mateo County.
[b]Combined to conceal output of a single operator in each.

[1]Bush, R. D., Weekly press bulletin, No. 481, Dept. of Petr. and Gas, Cal. State Min. Bur., Jan. 10, 1925.

The foregoing totals show a state average price of $1.200 per barrel for the year 1924, as compared to $0.923 in 1923 and $1.249 in 1922.

TABLE B.

Average Price of Oil per Barrel, by Counties, 1915-1924.

County	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Fresno	$0.452	$0.545	$0.516	$0.825	$1.191	$1.293	$1.483	$1.068	$1.710	$1.162
Kern	.409	.423	.641	.893	1.252	1.350	1.714	1.211	0.819	1.137
Los Angeles	.550	.629	.651	1.176	1.340	1.380	1.532	1.403	0.971	1.239
Orange	.675	.512	.663	1.003	1.412	1.860	2.138	1.175	0.880	1.183
San Luis Obispo	-------	-------	.450	.926	.905	1.040	1.400	0.942	0.600	0.992
Santa Barbara	.460	.611	.794	.808	1.235	1.125	1.575	1.011	0.782	1.036
Santa Clara	.530	.666	.666	1.387	1.700	1.600	1.485	1.616	1.404	1.921
Ventura	1.050	.855	1.045	1.318	1.480	1.635	2.507	1.785	1.138	1.334
State average	$0.461	$0.479	$0.636	$0.908	$1.278	$1.409	$1.726	$1.249	$0.923	$1.200

For several years previous to 1919, the state average value per barrel at the well for crude oil as determined by the statistical returns was noted to practically coincide with the quotations during the same years for 23° gravity oil in the San Joaquin Valley fields. In 1919 and since, the average values have worked out at figures corresponding to quotations up to, in one year as high as 28° oil, due to the large yield of high-gravity oils from the new fields in the Los Angeles-Orange counties area.

TOTAL PETROLEUM PRODUCTION OF CALIFORNIA.

The presence of oil seepages and springs in Los Angeles and Ventura counties was known and utilized in a small way early in the history of California. Some also was shipped to refineries at San Francisco from Santa Barbara and Humboldt counties. In the light of present-day developments, the following reference to the previous year's production of oil and its future prospects as expressed by the San Francisco Bulletin of January 8, 1866, is strikingly prophetic even though skeptical:

"It is possible that the small quantity received (40,000 or 50,000 gallons in 1865) may be the forerunner of many millions which will, at some future time, lubricate the wheels of commerce and set a trade at work excelling in variety any that has thus far been known on this coast. At present, however, we admit to being a little skeptical about the assumption of the astute Professor Silliman that California will be found to have more oil in its soil than all the whales in the Pacific Ocean."

According to Hanks,[1] in 1874 production amounted to 36 bbl. per day from natural flows in Pico Cañon (Newhall), and at Sulphur Mountain (Ventura County), the oil being of 32° gravity average.

[2] "Work was commenced in Pico Cañon in 1875, by drilling three shallow wells with spring pole, all of which yielded oil at depths of from 90 to 250 feet. Actual work of development commenced with steam machinery in 1877."

In 1877 Pico averaged 40-50 bbl. daily, and Ventura 80 bbl. daily. In 1878, there was some production (@ 60 bbl. per day, for a time) from wells in Moody Gulch, near Los Gatos, Santa Clara County, the oil being of 46° Baumé.

The first wells in the Coalinga, Fresno County, and Summerland, Santa Barbara County, fields were drilled in 1890, but Coalinga did not make its influence felt conspicuously on the state's annual output

[1] Hanks, Henry G., Report IV of State Mineralogist, p. 298, 1884.
[2] *Idem*, p. 301.

until 1903. The Summerland yield never has been large. The Salt Lake field near Los Angeles began production in 1894 and in 1897 reached over a million barrels annually.

In the Kern County fields, the first well was drilled in Sunset in 1891, Midway in 1900, McKittrick in 1892, Kern River in 1899. The Sunset-Midway district attained a yield of over 4,000,000 bbl. in 1909, and over 20,000,000 bbl. in 1910. Kern River field produced over 3,000,000 bbl. in 1901.

The first well in the Santa Maria-Lompoc group, Santa Barbara County, was drilled in 1901, and the district advanced to a yield of over 3,000,000 bbl. annually in 1905.

The Whittier-Fullerton field in Los Angeles and Orange counties became an important factor in 1902. The Montebello field, Los Angeles County, was the conspicuous addition in 1918-1919; and Elk Hills, Kern County, with Huntington Beach and Richfield, Orange County, in 1920. In 1921, the new fields added were Long Beach and Santa Fe Springs, Los Angeles County; in 1922, Torrance field in Los Angeles County, and Wheeler Ridge field in Kern County; but the production from the large number of new wells started in these new Los Angeles County fields did not reach its peak until August and September, 1923. Dominguez (Compton) came in during 1923; followed by Rosecrans and Inglewood in 1924.

The effect of the advent of these various fields to the producing column will be noted in the tabulation herewith, by years:

TABLE C.

Total Petroleum Production in California.

Year	Barrels	Value	Year	Barrels	Value
To and inc. 1875	(a) 175,000	(b) $472,500	1901	7,710,315	$2,961,102
1876	12,000	30,000	1902	14,356,910	4,692,189
1877	13,000	29,250	1903	24,340,839	7,313,271
1878	15,227	30,454	1904	29,736,003	8,317,809
1879	19,858	39,716	1905	34,275,701	9,007,820
1880	40,552	60,828	1906	32,624,000	9,238,020
1881	99,862	124,828	1907	40 311,171	16,783,943
1882	128,636	257,272	1908	48,306,910	26,566,181
1883	142,857	285,714	1909	58,191,723	32,398,187
1884	262,000	655,000	1910	77,697,568	37,689,542
1885	325,000	750,750	1911	84,648,157	40,552,088
1886	(a) 377,145	(b) 870,205	1912	89,689,250	41,868,344
1887	678,572	1,357,144	1913	98,494,532	48,578,014
1888	690,333	1,380,666	1914	102,881,907	47,487,109
1889	303,220	368,048	1915	91,146,620	43,503,837
1890	307,360	384,200	1916	90,262,557	57,421,334
1891	323,600	401,264	1917	95,396,309	86,976,209
1892	385,049	561,333	1918	99,731,177	127,459,221
1893	470,179	608,092	1919	101,182,962	142,610,563
1894	783,078	1,064,521	1920	103,377,361	178,394,937
1895	1,245,339	1,000,235	1921	112,599,860	203,138,225
1896	1,257,780	1,180,793	1922	138,468,222	173,381,265
1897	1,911,569	1,918,269	1923	262,875,690	242,731,309
1898	2,249,088	2,376,420	1924	228,933,471	274,652,874
1899	2,677,875	2,660,793			
1900	4,329,950	4,152,928	Totals	2,086,463,344	$1,886,744,622

[a] U. S. G. S., Min. Res. of U. S., 1886, p. 440, for quantities to and including 1886.
[b] Values have been estimated for the years to and including 1886, after consulting a number of contemporaneous publications, including the Mining & Scientific Press, Reports of the State Mineralogist, and U. S. Reports. The figures for 1887 to date are from records of the State Mining Bureau.

Well Data.

The following table is compiled from the monthly statements issued by the American Petroleum Institute:

TABLE D.

Well Operations, by Fields, 1924.

	Wells producing Dec., 1923	Wells producing Dec., 1924	Wells completed during year	Daily initial output	Wells abandoned during year	Barrels per well produced per day Dec., 1923	Barrels per well produced per day Dec., 1924
Kern River	2,143	2,158	10	238	----------	7.4	8.3
McKittrick	284	295	2	50	10	20.3	19.5
Midway-Sunset	2,322	2,940	191	51,324	14	33.3	36.2
Elk Hills	86	261	54	19,537	5	237.5	144.5
Lost Hills-Belridge	243	316	----------	----------	14	14.5	15.6
Coalinga	733	1,053	14	872	26	23.0	23.7
Wheeler Ridge	7	13	7	1,284	1	96.3	68.0
Watsonville	6	6	----------	----------	----------	9.5	9.5
Santa Maria-Lompoc	293	301	----------	----------	3	26.2	24.8
Summerland	135	135	----------	----------	----------	1.1	1.1
Ventura-Newhall	544	566	21	8,875	17	16.7	20.6
Los Angeles-Salt Lake	634	396	----------	----------	179	5.0	5.4
Whittier	179	178	----------	----------	1	10.8	11.0
Fullerton	386	389	2	339	1	29.3	29.6
Coyote	107	231	3	2,175	1	22.7	88.0
Santa Fe Springs	307	354	75	21,562	43	581.4	143.1
Montebello	116	160	7	1,335	5	91.4	109.3
Richfield	177	177	7	1,954	6	81.0	65.0
Huntington Beach	265	298	55	10,262	27	252.7	140.8
Long Beach	329	525	195	114,969	60	690.5	239.2
Torrance (Redondo)	99	510	531	169,399	26	317.2	88.1
Dominguez (Compton)	1	38	41	87,074	7	1,282.0	1,393.1
Rosecrans[a]	----------	17	21	17,330	----------	----------	449.3
Inglewood[b]	----------	2	2	365	----------	----------	50.5
Miscellaneous drilling	----------	----------	----------	----------	42	----------	----------
Totals	9,396	11,319	1,238	508,944	488	[c]75.2	[c]53.6

[a]Began producing May, 1924.
[b]Began producing September, 1924.
[c]State average.

Specific Gravities of Oils Produced.

The proportion of heavy and light oil produced in the various fields is shown in Table E. following, for which we are indebted to the Standard Oil Company. Under present practice, oil below 18° Baumé may be considered as largely refinable for fuel oil and lubricants, while the lighter oils yield varying amounts of the higher refined products with corresponding proportions of residuum and fuel oil. Specific gravities in California range from 8° Baumé in the Casmalia field, Santa Barbara County, to 56° Baumé in Ventura County.

California crude oils are all essentially of asphalt base, with a few notable exceptions. In the following localities are wells yielding crudes containing both asphalt and paraffine constituents: Oil City field, Coalinga; a few deep wells in East Side field, Coalinga; a considerable part of the Ventura County fields; Western Minerals area, south of Maricopa; Wheeler Ridge, Kern County.

TABLE E.

Production of Light and Heavy Oil, by Fields, 1924.

	Under 18° (barrels)	18° and over (barrels)	Total (barrels)
Kern River	6,711,983		6,711,983
McKittrick	2,121,444		2,121,444
Midway-Sunset	10,960,061	26,978,031	37,938,092
Elk Hills	1,302,151	12,303,888	13,606,039
Lost Hills-Belridge	503,369	1,033 011	1,536,380
Coalinga	4,257,606	5,802,018	10,059.624
Wheeler Ridge		342,420	342,420
Watsonville	23,790		23,790
Santa Maria	1,806,530	1,116,645	2,923,175
Summerland	51,215		51,215
Ventura-Newhall	48,369	4,005,116	4,053,485
Los Angeles-Salt Lake	900,813	25,154	925,967
Whittier-Fullerton	516,517	20,881,171	21,397,688
Santa Fe Springs		26,467,271	26,467,271
Huntington Beach	551,617	17,014,955	17,566,572
Long Beach	967,098	59,148,258	60,115,356
Torrance	1,893,734	15,656,935	17,550,669
Dominguez		6,841,981	6,841,981
Rosecrans		612,746	612,746
Inglewood	3,000	7,445	10,445
Miscellaneous	9,602	7,618	17,220
Totals	32,628,899	198,244,663	230,873,562

As previously noted by the writer,[1] a decided change has taken place in the relative proportions of light and heavy crudes produced in California since 1910, taking 18° Baumé as the dividing line. This subject has also been covered in detail and with charts, by Collom and Barnes.[2]

A marked drop took place in the low-gravity yield from 1910 to and including 1914. From 1914, it has remained almost stationary, with a slight drop in 1921, while the high-gravity yield has increased at a rapid rate since 1915. The proportions have been reversed from approximately 75% low—25% high in 1914 to 25% low—75% high in 1921; 10% low—90% high in 1923; and 14% low—86% high in 1924.

This has been an important factor in its effect upon the average price per barrel of the state's output in these years, as well as its effect upon the relative situation between production and consumption. It has been a fortunate development, in view of the increased demand for refinery products (gasoline, in particular), and the lessened demand for fuel oil owing in part to the shutting down during 1919–1922 of the western copper smelters which are large consumers of California fuel oil.

Oil in 'Storage.'

Field, refinery, pipe-line, and tank-farm stocks of crude and refinery products in Pacific Coast territory totaled 125,021,964 barrels,[3] December 31, 1924, compared with 116,727,442 barrels on December 31, 1923, distributed as follows:

Stocks	Dec. 31, 1924 (Barrels)	Dec. 31, 1923 (Barrels)
Heavy Crude, heavier than 20° A. P. I., including all grades of fuel	57,254,796	52,393,302
Refined Crude, 20° A. P. I., and lighter	40,574,578	36,880,942
Gasoline	10,957,487	7,696,815
Naphtha distillates	9,396,613	13,114,490
All other stocks	6,838,490	6,641,893
Total all stocks	125,021,964	116,727,442

[1] Bradley, W. W., Mineral production of California in 1921: Cal. State Min. Bur., Report XVIII, p. 442, Sept. 1922.

[2] Collom, R. E., and Barnes, R. M., California oil production and reserves: Cal. State Min. Bur., Ninth Ann. Rep. of State Oil and Gas Supervisor, Aug., 1923, pp. 5–23.

[3] Standard Oil Bulletin, February, 1925, p. 13.

Beginning with September, 1924, the American Petroleum Institute in reporting 'stocks' and 'storage' expanded their figures to include "stocks of all products held by the principal marketing companies at all points in all the Pacific Coast territory including British Columbia, Alaska, and Hawaii." Hence, the above tabulation is not comparable with the figures shown in our previous statistical reports which showed stocks in California only.

Operating Data.

The following tabulation (Table F) is compiled from data published by the Department of Petroleum and Gas,[1] semiannually, and here combined to show the entire year's operations for all fields. The 'districts' are the geographical subdivisions as administered by the Department, and which are outlined on the accompanying map.

It will be noted that the state average yield of oil per well per day was 68.0 barrels for the first six months of 1924 and 60.4 barrels for the second. This is somewhat higher than the figure of 53.6 barrels average for December derived from Standard Oil Company data as shown in Table D, on a preceding page, due in part at least, to the fact that the latter is on a full-time basis, whereas the Bureau figures allow for shut-down time.

[1]Summary of operations, California Oil Fields: Cal. State Min. Bur., Tenth Ann. Rep. of State Oil and Gas Supervisor, Aug. 1924, pp. 6–7; Feb. 1925, pp. 8–9.


OUTLINE MAP
OF
CALIFORNIA
SHOWING
APPROXIMATE LOCATION OF OIL FIELDS
Compiled by R D Bush, State Oil & Gas Supervisor
1 MOODY GULCH
2 SARGENT
3 COALINGA
4 DEVILS DEN
5 LOST HILLS
6 BELRIDGE
7 MCKITTRICK-TEMBLOR
8 MIDWAY-SUNSET
9 ELK HILLS
10 KERN RIVER
11 ARROYO GRANDE
12 CASMALIA
13 SANTA MARIA
14 CAT CANYON
15 LOMPOC
16 SUMMERLAND
17 VENTURA
18 SANTA PAULA
19 SOUTH MOUNTAIN
20 OJAI
21 SESPE
22 PIRU
23 BARDSDALE
24 SIMI
25 CONEJO
26 NEWHALL
27 BEVERLY HILLS
28 SALT LAKE
29 LOS ANGELES
30 MONTEBELLO
31 WHITTIER
32 SANTA FE SPRINGS
33 COYOTE HILLS
34 RICHFIELD
35 BREA-OLINDA
36 HUNTINGTON BEACH
37 LONG BEACH
38 TORRANCE
39 WHEELER RIDGE
-NOTE-
Oil District Boundaries.
40 DOMINGUEZ
41 ROSECRANS
42 INGLEWOOD
OREGON
NEVADA
MEXICO
PACIFIC OCEAN
SISKIYOU
MODOC
SHASTA
LASSEN
TRINITY
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
MENDOCINO
LAKE
COLUSA
YUBA
NEVADA
PLACER
YOLO
EL DORADO
SONOMA
NAPA
SOLANO
AMADOR
ALPINE
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
MONO
SAN FRANCISCO
ALAMEDA
STANISLAUS
MARIPOSA
MERCED
SANTA CLARA
SAN BENITO
MONTEREY
INYO
TULARE
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
RIVERSIDE
SAN DIEGO
IMPERIAL
SCALE

TABLE F—Production Statistics and Operating Data of California Oil Fields—1924.

Field	January 1 to June 30						July 1 to December 31					
	Average number of producing wells—actual	Oil (bbl.)	Number of days producing	Production per well per day (bbl.)		Percentage of time wells produced	Average number of producing wells—actual	Oil (bbl.)	Number of days producing	Production per well per day (bbl.)		Percentage of time wells produced
				Oil	Water					Oil	Water	
District No. 1:												
Beverly Hills	14	76,164	1,863	40.9	52.7	73.1	14	73,285	2,440	30.0	47.7	94.7
Brea Olinda	378	1,987,232	63,260	31.4	10.9	91.9	389	2,153,532	64,486	33.4	12.6	90.1
Coyote Hills	[a]161	1,894,136	27,599	68.6	31.7	94.2	218	3,747,576	38,749	95.9	45.9	96.6
Dominguez	6	856,031	940	910.7	16.9	86.1	28	5,894,730	4,299	1,371.2	15.7	83.4
Huntington Beach	278	9,691,853	45,883	211.2	15.7	90.7	[b]343	7,644,080	51,442	148.6	16.3	89.3
Inglewood							1	6,180	58	106.6	1.0	31.5
Long Beach	[a]403	34,278,304	66,642	514.4	15.0	90.9	[b]509	25,813,487	86,265	299.2	22.5	92.1
Montebello	157	3,086,775	26,946	114.6	38.3	94.4	159	3,143,515	27,699	113.5	47.2	94.7
Newhall	64	32,154	11,130	2.9	6.9	95.5	74	40,738	13,407	3.0	5.3	98.5
Newport							[b]4	20,250	465	43.5	19.4	63.2
Richfield	[a]181	2,381,754	31,255	76.2	6.4	94.9	[b]176	2,194,464	29,854	73.5	8.0	92.2
Rosecrans	1	40,607	55	738.3	15.4	30.2	8	493,896	1,085	455.2	4.1	73.7
Salt Lake	180	302,383	30,965	9.8	14.6	90.4	140	236,746	24,919	9.5	12.2	96.7
Santa Fe Springs	[a]361	16,151,853	56,226	287.3	13.6	85.6	[b]416	11,084,543	67,877	163.3	22.9	88.7
Torrance	240	7,550,114	34,048	221.7	2.3	77.9	[b]463	8,819,100	70,359	125.3	2.8	82.6
Whittier	165	392,721	25,948	15.1	22.4	86.4	[b]168	408,825	27,492	14.9	22.4	88.9
Totals	2,589	78,722,078	422,760	186.2	15.6	89.8	3,080	71,744,977	510,896	140.4	19.3	90.4
District No. 2:												
Bardsdale	143	177,612	25,416	7.0	1.2	97.7	144	186,346	25,629	7.3	1.1	96.7
Conejo	15	900	2,250	0.4	0.8	82.4	28	832	4,706	0.2	0.1	91.3
Ojai	76	41,204	12,205	3.4	1.9	88.2	75	39,827	12,440	3.2	1.7	90.1
Piru	99	59,545	15,790	3.8	5.7	87.6	101	65,360	16,562	3.9	11.7	89.1
Santa Paula	33	11,319	4,845	2.3	1.6	80.7	40	14,218	6,169	2.3	1.2	83.8
Sespe	23	20,531	4,080	5.0	0.8	97.5	22	25,321	3,992	6.3	0.8	98.6
Simi	52	34,293	8,034	4.3	1.5	84.9	51	31,520	8,225	3.8	1.5	87.6
South Mountain	47	683,179	8,192	83.4	0.5	95.8	52	719,855	9,067	79.4	0.1	94.8
Ventura	30	801,160	5,113	156.7	65.4	93.6	36	1,044,988	6,175	169.2	57.8	93.2
Totals	518	1,829,743	85,925	21.3	5.9	91.1	549	2,128,267	92,965	22.9	6.7	92.0

District No. 3:												
Arroyo Grande	19	16,370	3,183	5.1	5.9	92.0	19	14,852	3,157	4.7	4.9	90.3
Casmalia	94	517,414	15,288	33.8	202.9	89.4	94	523,379	15,415	34.0	214.5	89 1
Cat Canyon	31	285,855	5,078	56.3	9.7	93.0	35	291,566	5,893	47.8	8.1	91.5
*Half Moon Bay	4	388	362	1.1	0.3	49.2	4	388	362	1.1	0.3	49.2
Lompoc	1	19,271	182	105.9	0.9	100.0	1	18,959	184	103.0	0.5	100.0
Moody Gulch	3	334	546	0.6	0.5	100.0	3	338	552	0.6	0.3	100.0
Santa Maria	156	606,821	22,493	27.0	34.4	79.2	155	589,716	22,645	26.0	35.9	79.4
Sargent	9	6,980	1,638	4.3	0.0	100.0	9	6,765	1,656	4.1	0.0	100.0
*Summerland	134	26,100	22,305	1.2	12.9	90.6	134	26,100	22,305	1.2	12.9	90.6
Totals	451	1,479,533	71,075	20.8	59.5	86.6	454	1,472,063	72,169	20.4	62.0	86.4
District No. 4:												
Belridge-Lost Hills-Devils Den	251	636,062	41,879	15.2	47.2	92.2	77	330,100	12,705	26.0	21.0	89.7
Elk Hills	216	6,324,018	33,936	186.4	5.6	86.8	261	7,206,216	44,711	161.2	8.2	93.1
Kern River	2,161	3,306,720	374,918	8.8	47.6	95.9	2,186	3,212,311	383,468	8.4	49.8	95.3
McKittrick-Temblor	286	1,051,607	50,124	21.0	78.1	96.8	292	1,059,784	50,855	20.8	72.5	94.7
Midway-Sunset	2,731	17,858,958	459,228	38.9	20.0	92.9	2,887	19,837,369	497,686	39.9	21.2	93.7
Wheeler Ridge	10	161,910	1,524	106.2	2.0	81.2	12	190,350	2,069	92.0	2.8	93.7
Totals	5,655	29,339,275	961,639	30.5	34.4	94.0	5,715	31,836,130	991,494	32.1	34.3	94.3
District No. 5:												
Coalinga	1,086	5,372,398	175,997	30.5	12.2	89.0	1,085	4,784,007	186,389	25.7	10.5	93.4
Grand totals	10,299	116,743,027	1,717,396	68 0	27.1	91.6	10,883	111,965,444	1,853,913	60.4	27.5	92.6

[a]The exact production for some wells could not be obtained and the following estimates were incorporated in the above figures:

Coyote Hills	2	2,800	122
Long Beach	8	328,096	1,036
Huntington Beach	4	82,315	703
Richfield	2	15,126	413
Santa Fe Springs	3	58,767	278

[b]The exact production for some wells could not be obtained and the following estimates were incorporated in the above figures:

Huntington Beach	3	28,661	410
Long Beach	18	318,453	2,700
Newport	4	20,250	465
Richfield	1	662	60
Santa Fe Springs	1	17,390	175
Torrance	12	137,482	1,875
Whittier	10	3,000	1,500

*Estimated.

Financial and Operating Conditions of California Oil Fields, 1924.

Financial results of the oil business during 1924 are shown by the following tables. The features worthy of mention are: (1) The higher price received for the year as shown by the state average of all grades. (2) Decreases in the dividends paid by companies operating in Fresno and Los Angeles counties, and in the Kern River field, but an 8% increase in the state total of dividends for the year. (3) Decreases in the number of barrels per well per day yield (see Table I) in most of the older fields. (4) Somewhat higher operating costs per barrel in most of the fields.

With reference to Table I, it should be noted that although it lacks data from the larger operators who have refineries and with interests in more than one field, yet the data given are of economic value and interest in that they indicate the conditions prevailing among the smaller companies and operators.

Operating cost per well is not always lower for the dividend companies than others. Profitable operations seem to depend generally upon large wells, high grade oil, and proximity to market. Price and profits have usually been greater in the Los Angeles-Orange-Ventura fields than in others, doubtless largely due to the proximity to market and higher grades of oil. Crude oil testing as high as 56° Baumé is obtained from some of the Ventura wells.

TABLE G. CAPITALIZATION.

Field	Number of companies considered*	Per cent of total product of field	Capital	
			Cash	Property
Fresno County—Coalinga	59	26	$2,740,230	$22,014,927
Kern County:				
Kern River	63	32 5	8,769,085	7,841,714
Midway	71	40	5,377,950	45,230,394
Sunset-Maricopa	28		2,428,290	7,638,394
McKittrick, Lost Hills, Belridge, Devils Den, Elk Hills	42	10	2,392,478	5,713,996
Los Angeles County	121	14	3,743,123	28,205,377
Orange County	51	18	6,233,777	15,190,491
Santa Barbara County	20	36	3,676,014	34,470,502
Ventura County	40	44	1,284,070	17,052,557
Subtotals	495	--	$36,645,017	$183,358,352
Miscellaneous and marketing companies[a]	175	63	372,193,686	248,598,286
Totals	670	----------	$408,838,703	$431,956,638

*See Table I, following.

[a]Includes companies having refineries, and those operating in several fields whose data could not be segregated as to counties or fields.

TABLE H. Dividends Paid by Oil Companies, 1919-1924.

Field	1919		1920		1921		1922		1923		1924	
	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value
Coalinga	24	$1,352,969	29	$1,297,694	24	$1,142,767	20	$893,210	17	$383,675	13	$239,985
Kern River	27	1,235,877	26	783,625	28	390,794	20	594,306	13	187,170	20	67,468
Midway	32	8,360,447	39	7,096,819	34	4,311,539	30	2,706,985	19	2,438,695	31	3,528,930
Sunset and Maricopa	15	595,535	14	691,611	18	960,459	19	936,174	11	259,569	13	739,494
McKittrick, Belridge, Lost Hills, Devils Den, Elk Hills	9	548,224	12	1,231,045	13	2,603,490	10	733,460	11	1,021,602	5	1,594,497
Santa Barbara County	5	355,490	7	312,332	5	400,535	5	317,014	3	163,600	3	221,916
Ventura County	4	120,584	5	559,942	6	1,362,210	7	1,204,631	4	126,784	4	303,000
Los Angeles County	17	2,373,403	20	3,282,497	11	562,224	16	1,442,470	32	5,627,346	34	3,458,221
Orange County					11	1,395,158	8	331,345	12	897,119	11	2,717,050
Subtotals	133	$14,942,529	152	$15,255,565	150	$13,129,176	135	$9,159,595	122	$11,105,560	134	$12,870,561
Miscellaneous and marketing companies[a]	26	20,476,322	9	31,072,321	11	35,886,119	10	41,030,594	10	44,398,555	36	52,150,372
Totals	159	$35,418,851	161	$46,327,886	161	$49,015,295	145	$50,190,189	132	$55,504,115	170	$65,020,933

[a]See Table G, preceding.

TABLE I. Average Prices of Light and Heavy Oils, and Operating Data, 1924.

Field	Price				Operating data					
					All companies considered*			Dividend companies[a]		
	Under 18° Baume	18° and over	Average price	Price to dividend companies	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel
Fresno County—										
Coalinga	$0.946	$1.506	$1.462	$0.944	16.5	$6.14	0.372	18.5	$6.63	$0.358
Kern County—										
Kern River	0.992		0.992	1.011	8.2	2.93	0.357	6.8	2.29	0.337
Midway	0.948	1.204	1.164	1.263	48.8	13.13	0.269	55.5	14.87	0.268
Sunset and Maricopa	0.955	1.220	1.037	1.097	23.0	10.60	0.461	26.2	13.91	0.531
McKittrick, Lost Hills, Belridge, Devils Den, Elk Hills	1.066	1.241	1.172	1.139	16.3	5.26	0.323	21.4	5.97	0.279
Los Angeles County	0.827	1.257	1.239	1.189	105.2	52.71	0.501	108.1	33.19	0.307
Orange County	0.948	1.214	1.183	1.190	77.9	25.16	0.323	80.5	18.19	0.226
Santa Barbara County	0.723	1.353	1.036	1.351	34.6	16.64	0.481	40.4	18.26	0.452
Ventura County	0.900	1.339	1.334	1.352	20.5	12.24	0.597	79.4	23.03	0.290

*See Table G, preceding. Does not include companies with refineries, nor those operating in several fields whose data could not be segregated as to counties or fields. The data given are of value, however, as showing the conditions obtaining among the smaller operators.

[a]See Table H, preceding.

It should be noted that in the case of a county like Ventura, with only a few producers, the averages are not so significant as in other fields with a large number of operators. The figures of a single large operator in such a case can materially affect the general average if they should be much above or below the average of the others.

Proved Oil Land.

The total proved oil land of the state increased to 118,979 acres in 1924, against 116,868 acres in 1923. Of this 1924 total, 21,556 acres being owned by federal, state, and city governments, or for other reasons, is not assessable for the support of the Department of Petroleum and Gas of the State Mining Bureau. The acreage in 1924 was distributed by counties, as follows:

TABLE J.

Proved Oil Land and Number of Wells, 1924.

County	Land (acres)	Number wells
Fresno	14,646	1,105
Kern	74,270	6,015
Los Angeles*	10,763	2,212
Orange	6,902	1,082
San Bernardino	------	1
San Luis Obispo	402	19
San Mateo	------	4
Santa Barbara	7,813	377
Santa Clara	80	12
Ventura	4,103	529
Totals	118,979	11,356

*Not including the old Los Angeles City Field.

American Petroleum: Supply and Demand.

Because of the importance of an adequate petroleum supply to the future of the United States, not only from the economic and industrial standpoint, but social and political as well, the American Petroleum Institute has published in book form the report[1] of its committee which has investigated this subject. We quote the following as among the more important features of that report:

"The major factors of the investigation naturally concern the future supply of petroleum and the future demand of the country for petroleum products in time of peace or war.

"The American oil industry stands amongst the foremost of American industries. It is estimated that in its various branches—exploring, producing, refining, marketing and distributing—some 750,000 persons are employed and it represents an investment of more than nine billion dollars ($9,000,000,000). The persons having investments in the oil industry number many hundreds of thousands."

* * * * * * * * * *

"Summary of Conclusions.

"1. There is no imminent danger of the exhaustion of the petroleum reserves of the United States.

"2. It is reasonable to assume that a sufficient supply of oil will be available for national defense and for essential uses in the United States beyond the time when science will limit the demand by developing more efficient use of, or substitutes for, oil, or will displace its use as a source of power by harnessing a natural energy.

"3. Current supply and demand can not stay in balance, since the amount of both supply and demand are constantly changing. Generally current supply will exceed or be less than current demand, creating surplus or shortage; either condition will be reflected in price, but price will in time correct either condition.

"4. Petroleum recoverable by present methods of flowing and pumping from existing wells and acreage thus proven consist of five billion three hundred million (5,300,000,000) barrels of crude oil.

"5. It is estimated that after pumping and flowing there will remain in the area now producing and proved twenty-six billion (26,000,000,000) barrels of crude oil, a considerable portion of which can be recovered by improved and known processes such as flooding with water, the introduction of air and gas pressure and mining, when price justifies.

"6. Improved methods of deep drilling below oil sands now producing will disclose in many areas deposits not hitherto available, which will be tantamount to the discovery of new fields. Improved methods of producing have been perfected which will make possible recovery of oil from these lower levels. The limit of deep drilling has not been reached.

"7. The major oil reserves of the United States lie in some one billion one hundred million (1,100,000,000) acres of land underlain by sedimentary rocks, and not fully

[1] "American Petroleum: Supply and Demand," Amer. Petr. Inst., 1925.

explored, in which geology indicates oil is possible. With extended search new supplies will be found therein.

"8. The Nation has an additional reserve in the vast deposits of oil shale, coal and lignites from all of which liquid fuel and lubricants may be extracted if and when the cost of recovery is justified by the price of these products. These deposits are so huge that they promise, under conservative estimates, an almost unlimited supply.

"9. While this report is confined to the petroleum supply and demand within continental United States the importance of imports can not be ignored. Countries to the south are known to have large petroleum resources, for the output of which the United States is a natural market and the supply therefrom must inevitably have its influence on the consumption of American reserves.

"10. The availability of future petroleum supplies from the vast area of land mentioned above depends upon adequate incentives to the exploration which in the past has given the Nation a sufficient supply of petroleum, in peace and in war, throughout the history of the oil industry, from its inception in 1859.

"There must be: (a) Security in the ownership of oil lands and of the right to lease.

"(b) Conditions of exploration and development by owners or lessees permitting exercise of initiative, liberty of action, the play of competition and the free operation of the law of Supply and Demand.

"(c) Prices that will provide a return to producers, refiners, and distributors commensurate to the risks involved and the capital invested.

"11. The supply of petroleum will be made to go much further through more efficient utilization. Automotive experts state that the mileage of the motor car per gallon of gasoline may be doubled through structural mechanical changes, when price justifies such changes. Improved mechanics will also result in smaller consumption of lubricants.

"12. Through improved methods, principally the process known as 'cracking,' the refining branch of the industry has already increased the yield of gasoline, now the major product of petroleum. Through further improvements and extensions the supply of gasoline will be augmented still further by the 'cracking' of fuel oil. In consequence the supply of fuel oil will be correspondingly diminished, thus eventually removing fuel oil from competition with coal.

"13. Waste in the production, transportation, refining and distribution of petroleum and its products is negligible."

* * * * * * * * * *

"Demand Report.

"The Demand Report forecasts what the country's requirements of petroleum products and consequently crude oil will be for a period of fifty years. The estimates are based primarily on a study of the growth of national population industry, with calculations as to the increase in the automotive and other oil-consuming engines, with resultant increase in consumption, all leading to estimates of the total demand for oil, from decade to decade.

"In making its forecast the Committee on Demand has approached the subject on two bases—a minimum demand and a maximum demand. The minimum demand estimate sets forth the amount of oil necessary to meet the country's requirements if as is predicted will be the case, there occurs in the oil industry an extension of the refinery process of 'cracking' crude oil, which produces a much higher yield of gasoline, and if, as automotive engineers declare is mechanically possible, the efficiency of the internal combustion engine is improved so as to bring greater mileage per gallon per motor car.

"'Cracking' is already an established practice and its use is being rapidly extended throughout the oil industry. Further extension will vastly increase the yield of gasoline, now the major product of petroleum."

"Economies of Refining.

"The conservation of petroleum supplies by 'cracking' is already well advanced. By this process the heavier constituents of crude, such as kerosene and gas oil, are subjected to distillation at high temperatures in special stills. The treatment breaks down or 'cracks' a certain proportion of these heavier forms of oil into gasoline, leaving a correspondingly smaller residuum of heavy fuel oils or petroleum coke. The general adoption of this system of distillation would decrease to a marked extent the available supply of fuel and residue coke now available. The present yield of gasoline, according to the Bureau of Mines' statistics, is 33 per cent of the crude run to stills. This could be increased to 55 per cent. There is also a recovery of 25 per cent of lubricants, according to the Bureau of Mines.

"The Committee on Demand believes that if improvements in refining and in automotive engines are adopted as foreshadowed, a petroleum supply would be required of less than 500,000,000 barrels in 1950, as compared with 643,966,000 barrels actually run to stills in 1924. There would be in addition from the operations of 1950 approximately 200,000,000 barrels of residue—or the equivalent in residue coke—from complete cracking methods. This should take care of about 30 per cent of the estimated normal fuel oil demand of 641,000,000 barrels for that year, the balance to be taken care of from other sources, possibly oil shale or coal.

"Having arrived at the probable number of automotive engines at various periods the Committee on Demand has found it comparatively easy to figure what the demand for gasoline would be in future years were there no marked fuel saving improvements made in automotive engines. The gasoline consumption of the United States, according to the Bureau of Mines' figures, increased from 75,000,000 barrels of forty-two gallons in 1918 to 185,000,000 barrels in 1924. During the same period automotive engines increased from 6,500,000 to 18,000,000.

"The consumption of gasoline per car per year ranged from 11.13 barrels in 1918 to 9.67—the lowest point reached—in the lean business year of 1921—when the increase in registrations also was less than in any other. Since 1921 the consumption has been 9.92 barrels per vehicle in 1922, 10.10 in 1923, and 10.15 in 1924.

"The seven years' average of 10.0 barrels has been adopted as that on which future maximum demand for gasoline may safely be based. Were this ratio of demand to remain constant until 1950 the gasoline called for in that year would total 455,549,000 barrels."

"Fuel Oil Consumption.

"Due to a pronounced increase in total consumption of fuel oil, gas oil and crude oil used for fuel in 1923 and a subsequent decrease in 1924, it has been assumed that the consumption for these two years was of abnormal character, so the 1920 and 1922 figures have been used by the committee on demand to determine the normal curve for the five-year period from 1920 to 1925. The total consumption in the United States during 1922, according to the estimate of the United States Geodetic Survey, was 324,000,000 barrels.

"The Committee on Demand, basing its calculations on official and trade reports, estimated that of this total, including Diesel oil, industrial and domestic consumption aggregated 228,000,000 barrels; railroads used 44,000,000 barrels; the merchant marine, 32,000,000; the United States Navy, 6,000,000 and public utility electric plants 14,000,000 barrels.

"Normal increase of this demand during the next twenty-five years would result in a fuel oil requirement of 641,000,000 barrels in 1950. The subcommittee makes no attempt to prove that such a demand could be met, contenting itself with stating that:

" 'The demand for fuel oil has been approached from two angles— first by assuming that it would be forced by economic pressure to conform to the quantity of residuum left from the manufacture of gasoline and lubricants, and second, by considering the predicted growth of industrial uses to which fuel oil is peculiarly adapted as a source of energy.' "

"Intensive Drilling.

"From time to time the industry is spotted with a spectacular development of new fields of oil, which, due to intensive drilling and close spacing of wells, results in huge production sometimes in a remarkably speedy manner. These spectacular events are largely responsible for a public impression of extravagance and waste in the oil industry. Whatever may be said of the expense of intensive and speedy development of an oil field, the result of competitive effort on the part of many producing units, as against a more orderly development under ideal but unattainable conditions, it can be said that avoidable waste of oil itself is nominal. In fact, most experts agree that in most fields intensive development with closely spaced wells will bring forth more oil than slowly developed fields with widely spaced wells, and there is much in the record performance of certain fields to indicate that this is true."

"Rush for Production.

"A 'wildcat' well is often drilled in regions where property holdings are divided sometimes into quite small plots, and when oil is discovered a condition which is known in the oil industry as 'town lot drilling' ensues. When the 'wildcat' becomes a producer, the owner of neighboring property naturally drills a well as quickly as possible in order that his property will not be drained by the first well. Other neighbors follow and there is a mad rush by perhaps scores of property owners within the now-proven field to do likewise, and the field shortly presents a scene of terrific activity, with scores of wells being drilled. Pipe lines must be laid and storage facilities provided.

"The work goes on night and day. There is a great deal of competition and usually an appearance of confusion, which, not unnaturally, would give an impression of disorganization and consequent inefficiency and loss. But the fact remains that when the drills penetrate sands, and the gas pressure lifts the oil, perhaps in great volume, to the surface, the oil itself is turned into the pipe lines and safely sent to storage.

"Storage Problem.

"Frequently this intensive drilling and consequent speedy creation of a large supply of oil leads to a condition of surplus or over-production beyond the immediate needs of the consuming market, necessitating new storage in the form of concrete-lined reservoirs and steel tanks. In a recent work on the oil industry it is stated that in California's oil fields during 1923, $47,000,000 was spent on new storage.

"The cost of this storage becomes a serious expense to the industry which would not have been incurred if there could be an ideal condition where the reserves of the earth could be turned on and off as needed, in strict accordance with the demand for crude oil. In this respect it might be said that it is an economic waste, but, as indicated, there is no waste of oil itself, for methods of handling and storage are now such that the natural losses through leakage and evaporation are nominal."

CHAPTER THREE.

METALS.

Bibliography: Reports of State Mineralogist I–XXI (inc.). Bulletins 5, 6, 18, 23, 27, 36, 50, 57, 76, 78, 85, 92, 95. Spurr and Wormser, "Marketing of Metals and Minerals." See also under each metal.

The total value of metals produced in California during 1924 was $24,008,774. The chief of these is, and always has been, gold, followed in 1924 by copper, silver, quicksilver, tungsten, lead, zinc, platinum and manganese ore. There was a small output of iron ore and arsenic. There was no production of antimony, cadmium, molybdenum, nor tin, which have in the past been on the active list. Deposits of ores of nickel and vanadium have also been found in the state; although there has yet been no commercial output of them. The above-noted total for this group is a net increase of $2,388,805 over the 1923 total of $21,619,969, due mainly to an increase registered by copper, in spite of decreases by lead, gold and silver.

California leads all states in the Union in her gold production and is credited with approximately 30% of the nation's yield in 1924. The precious metal is widely distributed through the state. Thirty of the fifty-eight counties reported an output in 1924 from either mines or dredges.

Copper, which is second in importance among the metals of the state, occurs in the following general districts: the Shasta County belt, which has been by far the most important; the Coast Range deposits, extending more or less continuously from Del Norte in the north to San Luis Obispo County in the south; the Sierra Nevada belt, starting in Plumas and running in a general southerly and southeasterly direction through the Mother Lode counties and ending in Kern; the eastern belt in Mono and Inyo counties; and the southern belt, in San Bernardino, Riverside and San Diego counties.

Silver is not generally found alone in the state, except notably in the Rand district, San Bernardino County; but is associated to a greater or less extent with gold, copper, lead, and zinc.

Quicksilver has for many years been one of the state's staple products and California has supplied approximately 75% of the nation's output of this metal.

Tungsten is found in but few other localities of importance in the United States.

Large deposits of iron ore have long been known in several sections of the state, but for various economic reasons this branch of the mineral industry thus far has made only slight progress on the Pacific Coast.

A comparison of the 1924 metal output with that of the 1923 is afforded by the following table:

Substance	1923		1924		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Copper	28,246,860 lbs.	$4,166,989	52,089,349 lbs.	$6,823,704	$2,656,715+
Gold		13,379,013		13,150,175	228,838—
Iron ore	3,102 tons	18,665	[a]	[a]	———
Lead	9,934,522 lbs.	695,416	4,984,387 lbs.	398,751	296,665—
Manganese ore	690 tons	10,620	1,115 tons	25,785	15,165+
Platinum	602 fine oz.	78,546	273 fine oz.	36,452	42,094—
Quicksilver	5,458 flasks	332,851	7,948 flasks	543,080	210,229+
Silver	3,559,443 fine oz.	2,918,743	3,555,153 fine oz.	2,381,952	536,791—
Tungsten concentrates	34 tons	19,126	781 tons	446,009	426,883+
Zinc			3,060,000 lbs.	198,900	198,900+
Unapportioned[a]				3,966	3,966—
Total value		$21,619,969		$24,008,774	
Net increase					$2,388,805+

[a]Unapportioned includes iron ore and arsenic.

ALUMINUM.

Bibliography: Report XVIII, p. 198. Bulletins 38, 67. U. S. Geol. Surv., Min. Res. of U. S.

To date there has been no commercial production of aluminum ore in California. Only a single authenticated occurrence of bauxite has thus far been noted in this state, being in Riverside County, southeast of Corona, but as yet undeveloped.

Minerals containing aluminum are abundant, the most widely distributed being the clays. There are only two, however, thus far of consequence, commercially, in the production of the metal: bauxite (to which may be added to the related hydrated oxides, hydrargillite and diaspore) and cryolite. Cryolite is found in commercial quantities only in South Greenland, and was formerly the only ore of aluminum used, being still employed as a flux in the extraction of the metal. Bauxite has been, for some years, the most important source of aluminum and its salts. Its color varies from gray to red, according to the amount of iron present, the composition ranging usually between the following limits: Al_2O_3, 30%–60%; Fe_2O_3, 3%–25%; SiO_2, 0.5%–20%; TiO_2, 0.0%–10%. Besides its reduction to the metal, bauxite is also utilized in the manufacture of: aluminum salts, refractory bricks, alundum (fused alumina) for use as an abrasive; and in the refining of oil (stated to be of great importance). The most important producing countries, both of bauxite and the metal, are the United States and France, the former yielding more than 60 per cent of the world's output. In 1913 France led.

ANTIMONY.

Bibliography: State Mineralogist Reports VIII, X, XII, XIII, XIV, XV, XVII. Bulletin 38.

Production of antimony in California has been irregular, and small in amount except during the year 1916 when the high war-time prices permitted American producers, for a short period, to compete with Chinese antimony. The principal commercial production of antimony

in California has come from Kern, Inyo and San Benito counties, and other ocurrences have been noted in Nevada, Riverside and Santa Clara counties. The commonest occurence is in the form of the sulphide, stibnite; but in the Kernville and Havilah districts in Kern County there were notable deposits of the native metal, being among the few localities of the world where native antimony has been found.

Californian producers claim that they can not operate profitably unless the price of antimony be above 12 cents per pound. Present New York quotations are around 17 cents per pound, owing to a shortage of the metal as a result of the rioting and revolutionary fighting that has been going on in China for a number of months. China is the principal world source of antimony. As a consequence, there is a revival of antimony mining in California for the current year, 1925.

Pure antimony metal and manufactured antimony compounds are of considerable importance as pigments in the ceramic industry. The most important use of the metal, commercially, is in various alloys, particularly type-metal (with tin and lead), babbitt (with tin and copper), and britannia metal (with tin and copper).

Antimony Production of California, by Years.

The production of antimony in California by years since 1887 has been as follows:

Year	Tons	Value	Year	Tons	Value
1887	75	$15,500	1900	70	$5.700
1888	100	20,000	1901	50	8,350
1889			1902		
1893	50	2,250	1915	510	35,666
1894	150	6,000	1916	1,015	64,793
1895	33	1,485	1917	158	18,786
1896	17	2,320	1918		
1897	20	3,500			
1898	40	1,200	Totals	2,363	$199,050
1899	75	13,500			

ARSENIC.

Bibliography: Report XVIII. Bulletin 67. U. S. G. S., Min. Res. of U. S.

Arsenic is found in a number of localities in California in the mineral arsenopyrite (FeAsS), which is frequently gold bearing; and in scorodite ($FeAsO_4+2H_2O$), an oxidation product of arsenopyrite. The occurrence of realgar (AsS) has also been noted. The principal source of the arsenic of commerce in the United States has been as a by-product from the metallurgical treatment of copper, gold, and lead ores. It is usually recovered in the form of the tri-oxide, or 'white arsenic,' for which there is a demand for the preparation of insecticides, for use in agriculture and horticulture, and especially against the cotton-boll weevil in the southern states.

Up to the beginning of 1924, there had been no commercial recovery of arsenic from Californian ores. This year the plant of the Chipman Chemical Company at Bay Point began the preparation of arsenic compounds from Californian and Nevadan ores, by a chemical process.

As there was only the one operator, the amount and value are concealed under the 'unapportioned' total.

BERYLLIUM.

Bibliography: Eng. & Min. Jour.-Press, Vol. 118, No. 8, p. 285, Aug. 23, 1924.

Beryllium is a metal resembling aluminum closely in its chemical character, and has a specific gravity of 2.7. Several alloys have been prepared experimentally, of which copper-beryllium has received the most attention. The addition of 5% beryllium produces a golden-yellow alloy.

The compounds of beryllium at present used commercially are the nitrate and oxide. The nitrate is used by incandescent mantle manufacturers to harden the thorium oxide skeleton, the amount varying from 2 gm. to 5 gm. per kilogram of thorium nitrate. The oxide has been added to materials being used for the manufacture of abrasive compounds and in dental cements, and has also been recommended as a condensing agent in the preparation of certain esters. It is stated that this latter property may prove of value to manufacturers of synthetic perfumes and essences. Beryllium sulphate has been used to some extent in medical research.

There are a number of beryllium minerals, but none have been found in commercial quantities, except beryl, which is a beryllium-aluminum silicate carrying, when pure, 57% silica, 19% alumina, and 14% beryllium oxide. Beryl suitable for commercial purposes should carry from 10% to 12% beryllium oxide. The ore before use is ground to pass 90%–95% through a 200-mesh screen. It should be white in color, free from iron-bearing minerals and metallic iron. The price varies from 4¢ to 5¢ per pound in carload lots, according to demand and percentage of beryllium oxide. The chief use at present for ground beryl is as an addition to porcelain products, where it reduces the coefficient of expansion. Beryllium metal is difficult to separate from aluminum. For this reason, the mineral phenacite (Be_2SiO_4) would be a more desirable source for the metal, and it carries approximately 45% beryllium oxide.

Beryl occurs in California in the pegmatite dikes of the tourmaline gem district in northern San Diego and southwestern Riverside counties. Thus far there have been no commercial shipments of beryl except for gem purposes (the pink and aquamarine varieties).

BISMUTH.

Bibliography: Bulletins 38, 67. Am. Jour. Sci. 1903, Vol. 16.

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ochre) in the tourmaline gem district in San Diego and Riverside counties near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne and Mono counties, but only in small quantities. The only commercial production recorded was 20 tons valued at $2,400, in 1904, and credited to Riverside County.

In 1917, a few pounds of bismuthinite (Bi_2S_3) with associated bismutite ($Bi_2CO_5.H_2O$), was taken out at the United Tungsten Copper

Mine, in the Morongo district, San Bernardino County. It is associated with scheelite in a contact deposit between limestone and granite.

Recovery of bismuth from blister copper in the electrolytic refinery has been noted,[1] ranging as high as 27.3 pounds of metallic bismuth per 100 tons of blister copper from the Iron Mountain, Shasta County, ores. In the United States, the principal recovery of bismuth is obtained as a by-product from the refining of lead bullion.

The uses of bismuth are somewhat restricted, being employed principally in the preparation of medicinal salts, and in low melting-point or cliché alloys. These alloys are utilized in automatic fire sprinkler systems, in electrical fuses, and in solders.

Present quotations for bismuth are around $2.65 per pound for the refined metal.

CADMIUM.

Bibliography: U. S. Geol. Surv., Min. Res. of U. S., 1908, 1918.

During 1917 and 1918, cadmium metal was recovered by the electrolytic zinc plant of the Mammoth Copper Company in Shasta County. It was shipped in the form of 'sticks' and amounted to a total of several thousand pounds for the two years, the exact figures being concealed under 'Unapportioned.' That was the first, and thus far the only, commercial production of cadmium recorded from California ore. Cadmium there occurs associated with zinc sulphide, sphalerite, probably as the sulphide, greenockite. Cadmium also occurs in the Cerro Gordo Mine, Inyo County, associated with smithsonite (zinc carbonate).

There are several cadmium minerals, but none of them occur in sufficient quantities individually to be profitable as distinct ores. The cadmium of commerce is derived as a by-product in the reduction of zinc minerals and ores, in nearly all of which it occurs in at least minute proportions, the average ratio being about 1 of cadmium to 200 of zinc. As cadmium behaves metallurgically much the same as zinc, it constitutes a fraction of 1 per cent of nearly all metallic zinc.

Cadmium is produced in the United States in two forms—metallic cadmium and the pigment, cadmium sulphide. The principal use of the metal is in low-melting point, or cliché alloys, and its salts are utilized in the arts, medicine, and in electroplating. The sulphide is employed as a paint pigment, being a strong yellow, which is unaffected by hydrogen sulphide gas from coal smoke. It is also employed in coloring glass and porcelain. Cadmium cliché metal is stated to be superior to the corresponding bismuth alloy, for making stereotype plates. Cadmium is also used in bronze telegraph and telephone wires, and gives some promise of being utilized in electroplating.

Present quotations for cadmium are 60¢ per pound for the refined metal.

COBALT.

Bibliography: Report XIV. Bulletin 67. U. S. G. S., Min. Res. of U. S., 1912, 1918.

Occurrences of some of the cobalt minerals have been noted in several localities in California, but to date no commercial production has resulted. Some of the copper ores of the foothill copper belt in

[1] Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217–218.

Mariposa and Madera counties have been found to contain cobalt up to 3%. The most recent, and notable, occurrence thus far found in this state is in the Mar-John Mine near Sheep Ranch, Calaveras County. Lenses of smaltite ($CoAs_2$) have been uncovered in the vein, there, and several tons taken out in the course of development work; but as yet there have been no commercial shipments.

The most important use of cobalt is in the manufacture of the alloy, stellite, in which it is combined with chromium, for making high-speed lathe tools, and non-tarnishing cutlery and surgeons' appliances. The metal is also used in electroplating, similarly to nickel; and the oxide, carbonate, chloride, sulphate and other salts are used in ceramics for coloring. Some of the organic salts of cobalt (acetate, resinate, oleate) are employed as 'driers' in paint and varnish.

Present quotations for cobalt are $2.50 per pound for the refined metal.

COPPER.

Bibliography: State Mineralogist Reports VIII–XXI (inc.). Bulletins 23, 50, 91.

Copper is second only to gold among the metals produced in California. The output for 1924 amounted to a total of 52,089,349 pounds valued at $6,823,704, being nearly double the quantity and approximately a 65% increase in value over the 1923 figures which were 28,346,860 pounds worth $4,166,989. The increase was due mainly to resumption of operations in Shasta County, but in part also to a larger yield from Calaveras and Plumas counties. The average price in 1924 was 13.1¢ per pound, as against 14.7¢ in 1923, and 13.5¢ in 1922.

Plumas County ranked first for the year, with an output of 25,557,362 pounds; Shasta, second, with 21,109,958 pounds; and Calaveras, third, with 4,724,441 pounds.

Distribution of the 1924 copper output, by counties, was as follows:

Copper Production by Counties, 1924.

County	Pounds	Value
Calaveras	4,724,441	$618,902
Inyo	79,995	10,479
Madera	34,467	4,515
Plumas	25,557,362	3,348,015
Riverside	8,899	1,166
San Bernardino	17,667	2,314
Shasta	21,109,958	2,765,405
Trinity	550,000	72,050
Alpine, Amador, El Dorado, Kern, Los Angeles, Merced, Mono, Nevada, Orange, Sierra*	6,560	858
Totals	52,089,349	$6,823,704

*Combined to conceal output of a single operator in each.

Copper Production of the United States.

According to preliminary data issued by the U. S. Geological Survey,[1] the smelter production of primary copper from domestic sources during 1924 amounted to 1,634,249,192 pounds, an increase of approximately 14%. The value of smelter production increased approximately 1% in 1924. The average price of 2,620,000,000 pounds of copper delivered during the year, as reported to the Geological Survey by selling agencies, was 13.1¢ per pound.

[1]U. S. Geol. Surv., Press Bulletin 1978, June, 1925.

Tramway terminal and head-frame at the Superior Mine, Engels Copper Company, Plumas County.

"REFINED COPPER.

"The total production of new refined copper in 1924 was 2,260,000,000 pounds, an increase of 280,000,000 pounds over that in 1923.

"Primary and Secondary Copper Produced by Regular Refining Plants and Imported, 1923-1924, in Pounds.

"Primary:	1923	1924
Domestic:[a]		
Electrolytic	1,302,454,492	1,499,223,447
Lake	137,691,306	145,333,227
Casting	24,019,197	29,657,925
	1,464,164,995	1,674,214,599
Foreign:[a]		
Electrolytic	509,873,512	577,100,034
Casting	5,797,109	8,761,377
Refinery production of new copper	1,979,835,616	2,260,076,010
Imports of refined copper	[b] 160,711,227	145,909,968
Total new refined copper made available	2,140,546,843	2,405,985,978
Secondary:		
Electrolytic	85,297,052	104,281,430
Casting	46,141,409	50,536,678
	131,438,461	154,818,108
	2,271,985,304	2,560,804,086

[a]The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation of the amounts at this stage of manufacture is not possible.

[b]The figures of imports of refined copper from Chile, reported by the Chile Exploration Co., have been inserted in place of the figures of the Bureau of Foreign and Domestic Commerce for Chile, which are undoubtedly very low.

"In addition to their output of metallic copper the regular refining companies produced bluestone (hydrous copper sulphate) having a copper content of 5,766,000 pounds, as compared with 7,987,000 pounds in 1923.

"STOCKS.

"Stocks of Copper January 1, 1921, 1922, 1923, 1924 and 1925, in Pounds.

Year	Refined copper	Blister and material in process of refining
1921	659,000,000	465,000,000
1922	459,000,000	283,000,000
1923	216,000,000	361,000,000
1924	264,000,000	432,000,000
1925	243,000,000	393,000,000

"The amounts stated in the last column in the table above do not include copper in stock at foreign smelters or in transit from foreign smelters to refineries in the United States."

Copper Production of California by Years.

Although some mining of copper ores in a small way had been done earlier, shipments in appreciable quantities began in 1861 and continued of importance up to the end of 1867, when a total of 68,631 tons (of 2376 pounds) of high-grade ores, and 847 tons of matte or 'regulus'[1] had been shipped to smelters at New York, Boston, and Swansea, Wales. The most important district at that time was Copperopolis and vicinity in Calaveras County, with some shipments also made from Mariposa, El Dorado, and Fresno counties. From 1868 to 1882, the output was insignificant. There are wide discrepancies in the figures currently recorded for copper production previous to 1882 in which year the data of the U. S. Geological Survey began. The detailed statistics of the California State Mining Bureau began with the year 1894.

[1]Brown, J. Ross, Mineral Resources west of the Rocky Mountains, p. 168, 1867.

Amount and value of copper production in California annually since 1882 is given in the following tabulation:

Year	Pounds	Value	Year	Pounds	Value
1882	826,695	$144,672	1904	29,974,154	$3,969,995
1883	1,600,862	265,743	1905	16,997,489	2,650,605
1884	876,166	120,911	1906	28,726,448	5,522,712
1885	469,028	49,248	1907	32,602,945	6,341,387
1886	430,210	43,021	1908	40,868,772	5,350,777
1887	1,600,600	192,000	1909	65,727,736	8,478,142
1888	1,570,021	235,303	1910	53,721,032	6,680,641
1889	151,505	18,180	1911	36,838,024	4,604,753
1890	23,347	3,502	1912	34,169,997	5,638,049
1891	3,397,405	424,675	1913	34,471,118	5,343,023
1892	2,980,944	342,808	1914	30,491,535	4,055,375
1893	239,682	21,571	1915	40,968,966	7,169,567
1894	738,594	72,486	1916	55,809,019	13,729,017
1895	225,650	21,901	1917	48,534,611	13,249,948
1896	1,992,844	199,519	1918	47,793,046	11,805,883
1897	13,638,626	1,540,666	1919	22,162,605	4,122,246
1898	21,543,229	2,475,168	1920	12,947,299	2,382,303
1899	23,915,486	3,990,534	1921	12,088,053	1,559,358
1900	29,515,512	4,748,242	1922	22,883,987	3,090,582
1901	34,931,788	5,501,782	1923	28,346,860	4,166,989
1902	27,860,162	3,239,975	1924	52,089,349	6,823,704
1903	19,113,861	2,520,997	Totals	935,854,662	$152,907,960

GOLD.

Bibliography: State Mineralogist Reports I to XXI (inc.). Bulletins 36, 45, 57, 91. U. S. Geol. Surv., Prof. Paper 73.

Gold was the first and, for many years, the most important single mineral product of California. Although now surpassed for a number of years in annual value by petroleum, and by cement beginning with 1920, it still heads our metal list, and California continues to outrank all the other gold-producing states of the United States, including Alaska. In fact, at present California is producing approximately 30% of the gold mined in the entire United States.

While there is some renewal of activity in the development of gold lode properties, it has not yet become reflected in an increased yield of the metal. The 1924 figures show a slight decrease from the 1923 yield.

The production of gold in California in 1924 totaled 636,139.72 fine ounces, worth $13,150,175, being a decrease of 11,070.03 fine ounces from the 1923 yield. As the State Mining Bureau has never independently gathered the statistics of gold and silver production, these figures, as in former years, are published by cooperation with and through the courtesy of Mr. J. M. Hill of the U. S. Bureau of Mines, Department of Commerce (effective July 1, 1925, the former Mineral Resources Division of the U. S. Geological Survey was combined with the Bureau of Mines and transferred to the Department of Commerce).

The largest gold production for 1924 is reported from Nevada County, with an output of 136,419.04 fine ounces ($2,820.032); Amador County, with 130,927.34 ounces ($2,706,508) was second; followed by Yuba and Sacramento in third and fourth places, respectively. The drop of Yuba County from first place, which it has held recently, was due to a decline in dredge yield.

Distribution of the 1924 gold production, by counties, was as follows:

Gold Production by Counties, 1924.

County	Value	County	Value
Amador	$2,706,508	Mono	$49,651
Butte	484,530	Nevada	2,820,032
Calaveras	853,961	Placer	108,757
Del Norte	325	Plumas	277,571
El Dorado	28,207	Riverside	1,070
Fresno	32,978	Sacramento	1,150,687
Humboldt	1,269	San Bernardino	187,573
Imperial	258	San Diego	4,830
Inyo	19,977	Shasta	346,622
Kern	154,132	Sierra	799,276
Lassen	2,250	Siskiyou	63,570
Los Angeles	751	Stanislaus	196,019
Madera	3,208	Trinity	422,281
Mariposa	182,099	Tuolumne	255,994
Merced	355	Yuba	1,995,434
Total			$13,150,175

The following is quoted from the advance chapter on Gold in 1924, by courtesy of Mr. J. M. Hill of the U. S. Bureau of Mines:

"The gold production in California in 1924 is valued at $13,150,175, bringing the total production of the State to $1,776,177,215. It is difficult to credit the gold reported as produced in California to the several counties and to placers and deep mines, for much of the gold reaches the mint with no means of identifying its origin. A large part of this gold is won by small mine owners who do not respond to the Geological Survey's inquiries, and a considerable part is without doubt the result of operations by 'high-graders.' For 1924 it is estimated that at least $510,000 worth of gold belongs in this class. Bankers and storekeepers at such centers as Sonora, Angels Camp, Jackson, Nevada City, Grass Valley, Oroville, Redding, and Yreka purchase or ship gold that comes from a considerable territory tributary to those towns, and often no record is kept of the persons for whom the bullion is handled or of its origin. These lots are usually small, but in the course of a year they aggregate a considerable number of ounces, which must be apportioned according to the Survey's best judgment.

"In 1924 there were 41 companies that produced over 1,000 ounces of gold each, which contributed 91 per cent of the total gold output of California. Of these, 13 operated dredges, 24 operated gold quartz mines, 3 copper mines, 1 a silver mine, and 1 a gravel pit. The ten largest gold-producing companies, in order of output, were the Yuba Consolidated Gold Fields (5 dredges), Natomas Co. of California (8 dredges), Empire Mines Co. (gold quartz), North Star Mines Co. (gold quartz), Kennedy Mining & Milling Co. (gold quartz), Carson Hill Gold Mines (Inc.) (gold quartz), Argonaut Mining Co. (gold quartz), Sixteen to One Mines Co. (gold quartz), Central Eureka Mining Co. (gold quartz), Marigold Dredging Co. (1 dredge). These companies were likewise the largest producers of gold in 1923, but the relative production of the last 7 has changed.

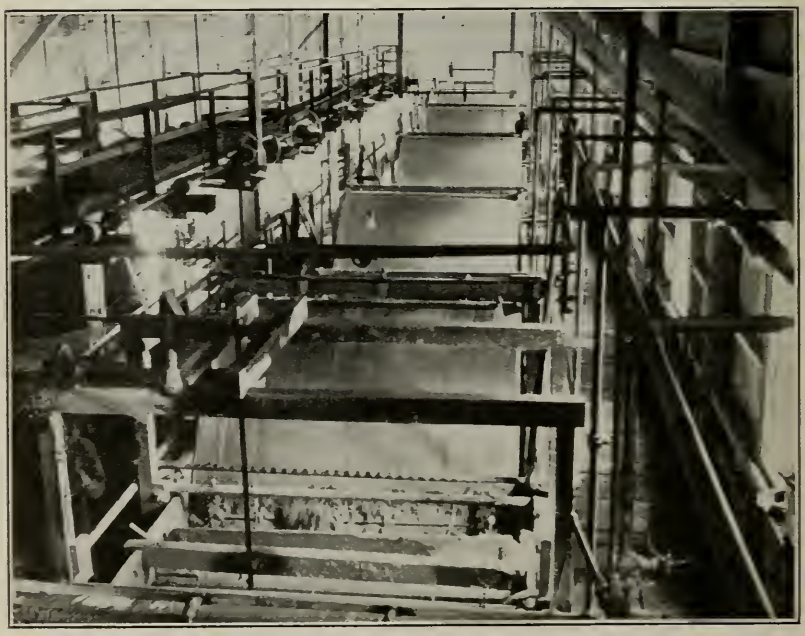
"Four counties produced more than $1,000,000 in gold in 1924, Calaveras having fallen below that figure. Nevada and Amador counties, whose production is from gold quartz mines, passed Yuba and Sacramento counties, whose dredge yield was considerably less than in 1923. Named in rank the counties in 1924 were: Nevada, $2,820,032; Amador, $2,706,508; Yuba, $1,995,434; Sacramento.$1,150,687.

"In 1924 deep mines produced 65 per cent and placer mines 35 per cent of the total gold output, as compared with 51 per cent and 49 per cent in 1923.

"The yield of placer-gold in 1924 was valued at $4,588,372, a decrease of 30 per cent as compared with 1923. The decrease was attributable almost entirely to the decrease of 29 per cent in yield of dredges, which produced 94 per cent of the total gold produced by placers, though due to drought conditions all classes of placer mining showed a decided falling off in production. There were 27 dredges, 51 drift mines, 47 hydraulic mines, and 141 surface placers operated in 1924. Drift mining in 1924 yielded 47 per cent, hydraulic mining 46 per cent, and surface or sluice mining 23 per cent less gold than in 1923. There was a considerable faling off of dredge production in Yuba and Shasta counties, and the only counties in which dredges worked that showed an increased yield were Butte and Stanislaus. The yield in gold from drift mines was $86,203 less than in 1923. There were slight gains in yield of drift mines in El Dorado, Plumas, and Tuolumne counties, but large declines in yield from those in Sierra, Nevada, Butte, and Calaveras counties. Gold produced at hydraulic mines in 1924 decreased $51,633 as compared with 1923. Siskiyou and Trinity County mines were most productive as usual, though in both counties the production of hydraulic mines was less than in 1923. Some gold was produced by surface mining in every county of the State that reported production, but the individual yield of this class of mining is relatively small.

"The production of gold from deep mines was valued at $8,561,803, an increase of 25 per cent as compared with the production in 1923. The yield from mines in Sierra, Tuolumne, and Calaveras counties declined, but in Amador, Nevada, Plumas, and Shasta there was a considerable increase—the two former counties from gold ores and the last two from copper ores. Of the 267 deep mines that reported production 29 reported production of gold exceeding $20,000 and only two of more than $1,000,000. Nevada County maintained its lead as premier producer of gold from deep mines, but Amador mines ran a close second. Practically 93 per cent of the gold produced by deep mines was from dry gold ores, 5 per cent from copper ores, and almost 2

Surface plant (head-frame and mill) of Idaho-Maryland Mine at Grass Valley, Nevada County.



Filters in cyanide plant of Empire Mine, Grass Valley, Nevada County.

per cent from silver ores. Of the total gold approximately 64 per cent was saved by amalgamation, 15 per cent by cyanidation, 15 per cent by smelting, and 6 per cent by hand-mortaring and melting."

Total Gold Production of California.

The presence of gold in stream gravels near Los Angeles was known and worked in a small way by the Indians, at least as early as 1841,[1] and possibly 1820.[2] On March 2, 1844, Don Manuel Castanares, deputy for California to the Congress of Mexico, reported[3] to his government that placers near Los Angeles had produced up to December, 1843, a total of 2000 ounces of gold dust, most of which had been sent to the United States mint at Philadelphia.

As the padres and the rancheros discouraged the quest of gold this early, small production caused no particular excitement. It was not until James W. Marshall's finding of gold nuggets in the tail-race of Sutter's saw mill on the American River, January 24, 1848, was heralded abroad that the great rush began, and California became a commonwealth of first rank almost over night. There are, however, no authentic data on gold production prior to 1848, other than occasional, scattered references such as above quoted.

The following table was originally compiled by Chas. G. Yale, of the Division of Mineral Resources, U. S. Geological Survey, but for a number of years statistician of the California State Mining Bureau and the U. S. Mint at San Francisco. The authorities chosen for certain periods were: J. D. Whitney, state geologist of California; John Arthur Phillips, author of "Mining and Metallurgy of Gold and Silver" (1867); U. S. Mining Commissioner R. W. Raymond; U. S. Mining Commissioner J. Ross Browne; Wm. P. Blake, Commissioner from California to the Paris Exposition, where he made a report on "Precious Metals" (1867); John J. Valentine, author for many years of the annual report on precious metals published by Wells, Fargo & Company's Express; and Louis A. Garnett, in the early days manager of the San Francisco refinery, where records of gold receipts and shipments were kept. Mr. Yale obtained other data from the reports of the director of the U. S. Mint and the director of the U. S. Geological Survey. The authorities referred to, who were alive at the time of the original compilation of this table in 1894, were all consulted in person or by letter by Mr. Yale with reference to the correctness of their published data, and the final table quoted was then made up.

[1]Hittell, T. H., History of California: Vol. II, p. 312, 1885.
[2]Bancroft, H. H., History of California: Vol. II, p. 417, 1886.
[3]Mercantile Trust Review of the Pacific, Vol. XIV, No. 2, p. 43, Feb. 15, 1925.

The figures since 1904 are those prepared by the U. S. Geological Survey:

Year	Value	Year	Value
1848	$245,301	1887	$13,588,614
1849	10,151,360	1888	12,750,000
1850	41,273,106	1889	11,212,913
1851	75,938,232	1890	12,309,793
1852	81,294,700	1891	12,728,869
1853	67,613,487	1892	12,571,900
1854	69,433,931	1893	12,422,811
1855	55,485,395	1894	13,923,281
1856	57,509,411	1895	15,334,317
1857	43,628,172	1896	17,181,562
1858	46,591,140	1897	15,871,401
1859	45,846,599	1898	15,906,478
1860	44,095,163	1899	15,336,031
1861	41,884,995	1900	15,863,355
1862	38,854,668	1901	16,989,044
1863	23,501,736	1902	16,910,320
1864	24,071,423	1903	16,471,264
1865	17,930,858	1904	19,109,600
1866	17,123,867	1905	19,197,043
1867	18,265,452	1906	18,732,452
1868	17,555,867	1907	16,727,928
1869	18,229,044	1908	18,761,559
1870	17,458,133	1909	20,237,870
1871	17,477,885	1910	19,715,440
1872	15,482,194	1911	19,738,908
1873	15,019,210	1912	19,713,478
1874	17,264,836	1913	20,406,958
1875	16,876,009	1914	20,653,496
1876	15,610,723	1915	22,442,296
1877	16,501,268	1916	21,410,741
1878	18,839,141	1917	20,087,504
1879	19,626,654	1918	16,529,162
1880	20,030,761	1919	16,695,955
1881	19,223,155	1920	14,311,043
1882	17,146,416	1921	15,704,822
1883	24,316,873	1922	14,670,346
1884	13,600,000	1923	13,379,013
1885	12,661,044	1924	13,150,175
1886	14,716,506		
		Total value	$1,777,122,457

IRIDIUM (see under Platinum).

IRON ORE.

Bibliography: State Mineralogist Reports II. IV. V. X. XII–XV (inc.). XVII. XVIII. XXI. Bulletins 38. 67. 91. Am. Inst. Min. Eng., Trans. LIII. Min. & Sci. Press, Vol. 115, pp. 112, 117–122; Vol. 123. pp. 94–96. 113–114.

A small tonnage of iron ore was produced in California during the year 1924. and utilized for foundry flux and in steel refining at open-hearth plants. As there was only a single operator. the figures are concealed under the 'unapportioned' total. There is also some tonnage utilized in the manufacture of paint pigment. and which is credited to 'mineral paint' in these statistical reports.

There are considerable deposits of iron ore known in California, notably in Shasta, Madera. Placer. Riverside and San Bernardino counties. but production has so far been limited for lack of an economic

supply of coking coal. Some pig-iron has been made, utilizing charcoal for fuel, both in blast furnaces and by electrical reduction; also, ferro-chrome, ferro-manganese, and ferro-silicon have been made in California.

Total Iron Ore Production of California.

Total iron ore production in California, with annual amounts and values, is as follows:

Year	Tons	Value	Year	Tons	Value
1881*	9,273	$79,452	1912	2,508	$2,508
1882	2,073	17,766	1913	2,343	4,485
1883	11,191	106,540	1914	1,436	5,128
1884	4,532	40,983	1915	724	2,584
1885			1916	3,000	6,000
1886	3,676	19,250	1917	2,874	11,496
1887			1918	3,108	15,947
1893	250	2,000	1919	2,300	13,796
1894	200	1,500	1920	5,975	40,889
1895			1921	1,970	12,030
1907	400	400	1922	3,588	18,868
1908			1923	3,102	18,665
1909	108	174	1924	[a]	[a]
1910	579	900			
1911	558	558	Totals	65,748	$521,919

*Productions for the year 1881-1886 (inc.) were reported as "tons of pig iron" (U. S. G. S., Min. Res. 1885), and for the table herewith are calculated to "tons of ore" on the basis of 47.6% Fe as shown by an average of analyses of the ores (State Mineralogist Report IV, p. 242). This early production of pig iron was from the blast furnaces then in operation at Hotaling in Placer County. Charcoal was used in lieu of coke. Though producing a superior grade of metal, they were obliged finally to close down, as they could not compete with the cheaper English and eastern United States iron brought in by sea to San Francisco.

[a]Concealed under 'unapportioned.'

LEAD.

Bibliography: State Mineralogist Reports IV, VIII–XV (inc.), XVII–XXI (inc.).

Lead production in California in 1924 decreased to approximately 50% of the amount shown in the preceding year. The principal output was from silver-lead ores from Inyo County. The total recoverable lead in ores shipped from Californian mines in 1924 amounted to 4,984,387 pounds valued at $398,751, compared with 9,934,522 pounds and $695,416 in 1923. The average price in 1924 was 8.0¢ as against 7.0¢ in 1923, 5.5¢ in 1922, and 3.9¢ in 1913.

The 1924 production was distributed by counties as follows:

Lead Production, by Counties, 1924.

County	Pounds	Value
Inyo	4,813,718	$385,098
Mono	32,458	2,597
Riverside	26,817	2,145
San Bernardino	31,668	2,533
Shasta	6,615	529
Alpine, Amador, Calaveras, Kern, Los Angeles, Merced, Nevada, Orange*	73,111	5,849
Totals	4,984,387	$398,751

*Combined to conceal output of a single operator in each.

Lead Production of California, by Years.

Statistics on lead production in California were first compiled by this Bureau in 1887. Amount and value of the output, annually, with total figures, to date, are given in the following table:

Year	Pounds	Value	Year	Pounds	Value
1887	1,160,000	$52,200	1907	328,681	$16,690
1888	900,000	38,250	1908	1,124,483	46,663
1889	940,000	35,720	1909	2,685,477	144,897
1890	800,000	36,000	1910	3,016,902	134,082
1891	1,140,000	49,020	1911	1,403,839	63,173
1892	1,360,000	54,400	1912	1,370,067	61,653
1893	666,000	24,975	1913	3,640,951	160,202
1894	950,000	28,500	1914	4,697,400	183,198
1895	1,592,400	49,364	1915	4,796,299	225,426
1896	1,293,500	38,805	1916	12,392,031	855,049
1897	596,000	20,264	1917	21,651,352	1,862,016
1898	655,000	23,907	1918	13,464,869	956,006
1899	721,000	30,642	1919	4,139,562	219,397
1900	1,040,000	41,600	1920	4,903,738	392,300
1901	720,500	28,820	1921	1,149,051	51,707
1902	349,440	12,230	1922	6,511,280	358,120
1903	110,000	3,960	1923	9,934,522	695,416
1904	124,000	5,270	1924	4,984,387	398,751
1905	533,680	25,083			
1906	338,718	19,307	Totals	118,185,129	$7,443,063

MANGANESE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV, XVIII. Bulletins 38, 67, 76, 91. U. S. G. S., Bull. 427. Eng. & Min. Jour.-Press, Vol. 117, p. 545.

Manganese ore shipments in California in 1924 amounted to a total of 1115 tons of all grades valued at $25,785, being an increase in both quantity and value over the 1923 yield which totaled 690 tons and $10,620 value. These ores showed analyses of from 46% to 59% Mn and were utilized almost entirely by Pacific Coast plants for ferro-manganese.

Importations of foreign manganese ores in 1924, mainly from Brazil, amounted to a total of 255,157 long tons valued at $6,084,686, compared with 206,048 tons and $3,874,510 in 1923. The tariff act of 1922 provides for an import duty of 1¢ per pound on the metallic manganese contained, for "manganese ore or concentrates containing in excess of 30 per centum of metallic manganese." The bulk of such ore is consumed in the large steel-producing centers of the eastern United States.

Manganese Ore Production in California, by Years.

Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5000 tons had been produced by that property. For some years following that, the output was small. The tabulation herewith shows the California output

of manganese ore, annually, since 1887, when the compilation of such figures was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1887	1,000	$9,000	1907	1	$25
1888	1,500	13,500	1908	321	5,785
1889	53	901	1909	3	75
1890	386	3,176	1910	265	4,235
1891	705	3,830	1911	2	40
1892	300	3,000	1912	22	400
1893	270	4,050	1913		
1894	523	5,512	1914	150	1,500
1895	880	8,200	1915	4,013	49,098
1896	518	3,415	1916	13,404	274,601
1897	504	4,080	1917	15,515	396,659
1898	440	2,102	1918	26,075	979,235
1899	295	3,165	1919	11,569	451,422
1900	131	1,310	1920	2,892	62,323
1901	425	4,405	1921	1,005	12,210
1902	870	7,140	1922	540	7,650
1903	1	25	1923	690	10,620
1904	60	900	1924	1,115	25,785
1905					
1906	1	30	Totals	86,444	$2,359,404

MOLYBDENUM.

Bibliography: State Mineralogist Reports XIV, XVII. Bulletin 67. U. S. Bur. of Min., Bulletin 111. Proc. Colo. Sci. Soc., Vol. XI.

Molybdenum is used as an alloy constituent in the steel industry, and in certain forms of electrical apparatus. Included in the latter is its successful substitution for platinum and platinum-iridium in electric contact-making and breaking devices. In alloys it is used similarly to and in conjunction with chromium, cobalt, iron, manganese, nickel, tungsten, and vanadium. The oxides and the ammonium salt have important chemical uses.

The two principal molybdenum minerals are: the sulphide, molybdenite; and wulfenite, lead molybdate; the former furnishing practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as granite and pegmatite. The chief commercial sources have been New South Wales, Queensland, and Norway, with some also from Canada.

Deposits of disseminated molybdenite are known in several localities in California, and in at least two places it occurs in small masses associated with copper sulphides. The only recorded commercial shipments of molybdenum ore in California were during the war, 1916–1918. Some development work has ben recently done on a high-grade deposit at the head of the Kaweah River, Tulare County.

Present quotations for molybdenum ore are 65¢–70¢ per pound for 85% MoS_2 concentrates.

California's production of molybdenum ore by years is summarized in the following tabulation:

Year	Tons	Value
1916	8	$9,945
1917	243	9,014
1918	*	300
Totals	251	$19,259

*300 pounds of 90% MoS_2 concentrate.

NICKEL.

Bibliography: State Mineralogist Reports XIV, XVII. U. S. C. S., Bulletin 640–D. U. S. Bureau of Standards, Circular 100.

Nickel occurs in the Friday Copper Mine in the Julian District, San Diego County. The ore is a nickel-bearing pyrrhotite, with some associated chalcopyrite. Some ore has been mined in the course of development work, but not treated nor disposed of, as they were unable to get any smelter to handle it for them. Nickel ore has also been reported from other localities in California, but not yet confirmed.

Present quotations for nickel are around 34¢ per pound for the refined metal.

OSMIUM (see under Platinum).

PALLADIUM (see under Platinum).

PLATINUM.

Bibliography: State Mineralogist Reports IV, VIII, IX, XII–XVIII. Bulletins 38, 45, 67, 85, 91, 92. U. S. Geol. Surv. Bulletins 193, 285. Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217–218.

In California platinum is obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges working in Butte, Calaveras, Sacramento, Stanislaus, and Yuba counties, with smaller amounts from the hydraulic and surface-sluicing mines of Del Norte, Humboldt, Shasta, Siskiyou and Trinity.

The production of platinum-group metals in California for the year 1924 totaled 337 ounces, crude, containing 273 fine ounces, valued at $36,452. Of this amount, a total of 275 ounces, crude, or 82%, came from the gold dredges. This is less than 50% of the 602 fine ounces worth $78,546 sold in 1923, the decrease being due to cessation of dredging in Shasta and to a lessened output in Yuba County.

The above noted total of 273 fine ounces includes 84 fine ounces of osmiridium and iridium, also some palladium. Most of the platinum refiners pay for the osmiridium on the basis of its iridium content. Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium, and osmiridium or iridosmine, with occasionally some palladium. Iron, in amount from

5% to 15% is found alloyed naturally with most platinum as are also smaller amounts of palladium, rhodium, iridium, and osmium. also sometimes from 0.5% to 2% of copper. Osmiridium (iridosmine) sometimes also carries ruthenium in addition to the other members of the group above mentioned.

In addition to the above-noted production, there is usually some platinum recovered as a by-product in the gold refinery of the mint, but which can not be assigned to the territory of its origin for lack of knowing to which lots of gold it belongs. The San Francisco mint has recovered as high as 100 ounces of platinum in a single year from this source, some of which unquestionably came from California mines. Some platinum and palladium are also recovered in the electrolytic refining of blister copper.

According to Hill,[1] the refined platinum metals recovered in 1924 by refiners of the United States from crude platinum, from ore and concentrates, and from gold and copper refining amounted to 66,007 ounces of which 7,280 ounces is believed to have come from domestic materials.

For 1924, the distribution by counties of California's platinum yield was as follows:

Platinum Production by Counties, 1924.

County	Fine ounces	value
Butte	[a] 20	$2,829
Shasta	27	3,361
Trinity	11	1,839
Yuba	73	8,773
Calaveras, Del Norte, Humboldt, Mendocino, Sacramento,[a] Siskiyou, Stanislaus*	142	19,650
Totals	273	$36,452

[a]Includes palladium.
*Combined to conceal output of a single operator in each.

Russia, previous to 1916, was producing from 90% to 95% of the world's platinum, but for several years following was reduced to practically nothing; and has not yet recovered her former position. Colombia ranked in second place, but now leads. California is the leading producer in the United States.

Uses, Markets, and Consumption.

Besides its well-known uses in jewelry, dentistry and for chemicalware, an important industrial development of recent years employs platinum as a catalyzer in the 'contact process' of manufacturing concentrated sulphuric acid. It is also necessary for certain delicate parts of the ignition systems in automobiles, motor boats and aeroplanes. Experiments have been made to find alloys which can replace platinum for dishes and crucibles in analytical work, but so far with only slight success.

[1]Hill, J. M., Platinum and allied metals in 1924: U. S. Geol. Surv., Press Bull., June 18, 1925.

According to Hill[1] the total consumption of platinum metals in the United States in 1924 was 165,018 troy ounces, a decrease from that consumed in 1923, distributed as follows:

"Platinum Metals Consumed in the United States as Reported by Refiners, 1923 and 1924, by Industries, in Troy Ounces.

Industry	Platinum	Iridium	Palladium	Others	Total	Percentage of total
1924						
Chemical	10,507	122	436	403	11,468	7
Electrical	16,588	1,269	3,099	----------	20,956	13
Dental	11,092	131	10,049	----------	21,272	13
Jewelry	87,151	2,204	12,480	746	102,581	62
Miscellaneous	5,012	634	2,122	973	8,741	5
Totals	130,350	4,360	28,186	2,122	165,018	100
1923						
Chemical	8,637	190	485	266	9,578	5
Electrical	18,596	1,675	3,666	----------	23,937	13
Dental	16,288	153	10,116	----------	26,557	14
Jewelry	105,699	3,073	14,948	190	123,910	65
Miscellaneous	3,156	1,403	986	1,256	6,801	3
Totals	152,376	6,494	30,201	1,712	190,783	100

"Stocks.

"At the end of 1924 the stocks of crude platinum metals in the hands of refiners was 74,539 ounces, an increase of 3,814 ounces as compared with stocks on January 1.

"Stocks of platinum metals in hands of refiners in the United States December 31, 1919-1924, in troy ounces:

Metal	1919	1920	1921	1922	1923	1924
Platinum	29,228	46,747	38,514	41,900	36,554	40,464
Iridium	3,359	4,196	4,991	7,559	5,208	3,622
Palladium	10,235	16,565	21,042	24,975	26,266	27,400
Others	610	216	3,113	1,583	2,697	3,053

Platinum Production of California by Years.

The annual production and value since 1887, have been as follows:

Year	Ounces	Value	Year	Ounces	Value
1887	100	$400	1906	91	$1,647
1888	500	2,000	1907	300	6,255
1889	500	2,000	1908	706	13,414
1890	600	2,500	1909	416	10,400
1891	100	500	1910	337	8,386
1892	80	440	1911	521	14,873
1893	75	517	1912	663	19,731
1894	100	600	1913	368	17,738
1895	150	900	1914	463	14,816
1896	162	944	1915	667	21,149
1897	150	900	1916	886	42,642
1898	300	1,800	1917	619	43,719
1899	300	1,800	1918	571	42,788
1900	400	2,500	1919	*418	60,611
1901	250	3,200	1920	477	68,977
1902	39	468	1921	613	58,754
1903	70	1,052	1922	795	90,288
1904	123	1,849	1923	602	78,546
1905	200	3,320	1924	273	36,452
			Totals	13,900	$678,876

*Fine ounces, beginning with 1919.

[1] *Idem.*

QUICKSILVER.

Bibliography: State Mineralogist Reports IV, V, XII–XV, XVII–XIX (inc.). Bulletins 27, 78, 91. U. S. Geol. Surv., Monograph XIII. U. S. Bur. of Mines, Tech. Papers 96,227; Bulletin 222.

Quicksilver was produced in California in seven counties during 1924 to the amount of 7948 flasks valued at $543,080, being an increase of nearly 50% both in amount and value over the 1923 output of 5458 flasks and $332,851. The average price received during 1924, according to the producers' reports to the State Mining Bureau, was $68.33 per flask, as against $60.98 in 1923, and the record average of $114.03 for the year 1918.

The average of San Francisco quotations for 1924 was $68.69 per flask, the price varying from $59.35 in January, to $75 in April, declining to $69 early in December, but ending the year at $72.65. For the current year, 1925, quotations are ranging higher, the average for the month of September being $81.73.

The above noted yield of 7948 flasks in 1924 was won from a total of 61,595 tons of ore, being an average content of 9.7 pounds per ton, or 0.485% mercury.

The increase in 1924 was due to greater output at the New Idria Mine in San Benito County.

The U. S. Geological Survey reports the total production of the United States for 1924 at 9600 flasks (75 pounds, net), valued at $659,424 (using the $68.69 average of quotations). Outside of California, the principal yield was from Texas, with a few flasks from Nevada, Oregon, Idaho, and Alaska. California's contribution was 82.5% of the total.

According to the bureau of Foreign and Domestic Commerce records, there was imported a total of 12,076 flasks of quicksilver in 1924, mainly from Spain and Italy, compared with 20,915 flasks and $901,031 in 1923. In 1924, a total of 208 flasks, valued at $14,333, was exported, as against 318 flasks worth $25,195 in 1923.

The 1923 quicksilver production in California was distributed by counties, as follows:

Quicksilver Production by Counties, 1924.

County	Flasks	Value
San Benito	4,670	$320,758
Sonoma	867	60,840
Lake, Monterey, Napa, Santa Clara, San Luis Obispo*	2,411	161,482
Totals	7,948	$543,080

*Combined to conceal output of a single operator in each.

Uses.

The most important uses of quicksilver are the recovery of gold and silver by amalgamation, and in the manufacture of fulminate for explosive caps, of drugs, of electric appliances, and of scientific apparatus. By far the greatest consumption is in the manufacture of fulminate and drugs.

Total Quicksilver Production of California.

Total amount and value of the quicksilver production of California, as given in available records, is shown in the following tabulation.

Though the New Almaden Mine in Santa Clara County was first worked in 1824, and has been in practically continuous operation since 1846 (though the yield was small the first two years), there are no available data on the output earlier than 1850. Previous to June, 1904, a 'flask' of quicksilver contained 76½ pounds, but since that date 75 pounds. In compiling this table the following sources of information were used: for 1850–1883, table by J. B. Randol, in Report of State Mineralogist, IV, p. 336; 1883–1893, U. S. Geological Survey reports; 1894 to date, statistical bulletins of the State Mining Bureau; also State Mining Bureau, Bulletin 27, "Quicksilver Resources of California," 1908, p. 10:

Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99 45	1888	33,250	$1,413,125	42 50
1851	27,779	1,859,248	66 93	1889	26,464	1,190,880	45 00
1852	20,000	1,166,600	58 33	1890	22,926	1,203,615	52 50
1853	22,284	1,235,648	55 45	1891	22,904	1,036,406	45 25
1854	30,004	1,663,722	55 45	1892	27,993	1,139,595	40 71
1855	33,000	1,767,150	53 55	1893	30,164	1,108,527	36 75
1856	30,000	1,549,500	51 65	1894	30,416	934,000	30 70
1857	28,204	1,374,381	48 73	1895	36,104	1,337,131	37 04
1858	31,000	1,482,730	47 83	1896	30,765	1,075,449	34 96
1859	13,000	820,690	63 13	1897	26,691	993,445	37 28
1860	10,000	535,500	53 55	1898	31,092	1,188,626	38 23
1861	35,000	1,471,750	42 05	1899	29,454	1,405,045	47 70
1862	42,000	1,526,700	36 35	1900	26,317	1,182,786	44 94
1863	40,531	1,705,544	42 08	1901	26,720	1,285,014	48 46
1864	47,489	2,179,745	45 90	1902	29,552	1,276,524	43 20
1865	53,000	2,432,700	45 90	1903	32,094	1,335,954	42 25
1866	46,550	2,473,202	53 13	1904	*28,876	1,086,323	37 62
1867	47,000	2,157,300	45 90	1905	24,655	886,081	35 94
1868	47,728	2,190,715	45 90	1906	19,516	712,334	36 50
1869	33,811	1,551,925	45 90	1907	17,379	663,178	38 16
1870	30,077	1,725,818	57 38	1908	18,039	763,520	42 33
1871	31,686	1,999,387	63 10	1909	16,217	773,788	47 71
1872	31,621	2,084,773	65 93	1910	17,665	799,002	45 23
1873	27,642	2,220,482	80 33	1911	19,109	879,205	46 01
1874	27,756	2,919,376	105 18	1912	20,600	866,024	42 04
1875	50,250	4,228,538	84 15	1913	15,661	630,042	40 23
1876	75,074	3,303,256	44 00	1914	11,373	557,846	49 05
1877	79,396	2,961,471	37 30	1915	14,199	1,157,449	81 52
1878	63,880	2,101,652	32 90	1916	21,427	2,003,425	93 50
1879	73,684	2,194,674	29 85	1917	24,382	2,396,466	98 29
1880	59,926	1,857,706	31 00	1918	22,621	2,579,472	114 03
1881	60,851	1,815,185	29 83	1919	15,200	1,353,381	89 04
1882	52,732	1,488,624	28 23	1920	10,278	775,527	75 45
1883	46,725	1,343,344	28 75	1921	3,157	140,666	44 56
1884	31,913	973,347	30 50	1922	3,466	191,851	55 35
1885	32,073	986,245	30 75	1923	5,458	332,851	60 98
1886	29,981	1,064,326	35 50	1924	7,948	543,080	68 33
1887	33,760	1,430,749	42 38				
				Totals	2,205,856	$107,909,288	

*Flasks of 75 lbs. since June, 1904; of 76½ lbs. previously.

SILVER.

Bibliography: State Mineralogist Reports IV, VIII, XII–XXI (inc.). Bulletins 67, 91. Min. & Sci. Press, March 1, 1919.

Except for the early-day production of the silver mines of the Calico district and the more recent production from those of the Randsburg district (both being in San Bernardino County), the recovery of silver

in California has been largely as a by-product from its association with copper, lead, zinc, and gold ores.

The 1924 silver output of California totaled 3,555,153 fine ounces, valued at $2,381,952, compared with 3,559,443 fine ounces and $2,918,743 in 1923. The average price of domestic silver during 1924 was 67¢ per ounce at New York, as against 82¢ in 1924, and $1.00 in 1921-1923 under the Pittman Act. The figures below are those of the U. S. Bureau of Mines, Department of Commerce (as explained under Gold), to which has been added a small figure from Alpine County not included by that bureau, being less than $100.

The following paragraph is quoted from the U. S. Bureau of Mines, Department of Commerce, Advance Chapter on Gold and Silver for 1924, by courtesy of Mr. J. M. Hill, statistician in charge of the San Francisco branch office:

"The production of silver in 1924 was 3,555,133 ounces, only 4,310 ounces less than in 1923, but the value decreased 18 per cent. Ninety-nine per cent of the total silver output of California in 1924 was produced by the 49 mines that contributed over 1,000 ounces each. At 25 properties between 1,000 and 5,000 ounces was produced, at 8 between 5,000 and 10,000 ounces, at 11 between 10,000 and 50,000 ounces, at 4 between 100,000 and 300,000 ounces, and at 1 (California Rand Silver, Inc.) more than 2,000,000 ounces. The mines with an output of over 100,000 ounces were copper mines in Plumas and Shasta counties. No lead mines produced over 50,000 ounces of silver in 1924. San Bernardino County held first rank in silver production, followed by Shasta and Plumas counties. The 10 largest silver producers in the State, named in order of rank, were the California Rand Silver (Inc.) (silver ore), U. S. Smelting, Refining & Mining Co. (Mammoth mines) (copper ore), Walker Mining Co. (copper ore), Engels Copper Co. (copper ore), Tecopa Cons. Mining Co. (lead ore), Darwin Silver Co. (lead ore), Zenda Mining Co. (gold ore), Cerro Gordo Mines Co. (lead ore), Estelle Mines Co. (lead ore), Empire Mines Co. (gold quartz).

"That the silver output did not decline more than it did is due to the great expansion of copper mining, for the lead mines were much less productive in silver and the output of the California Rand declined considerably. The silver production of Shasta County increased nearly nine-fold, due to the greater extent of copper mining, and there were notable increases in yield of silver from Plumas, Mono, Kern, Trinity, and Amador counties.

"In 1924 the yield of silver from placer mines was 16,690 ounces, 0.47 per cent of the State total and a decrease of 18 per cent as compared with 1923. The dredges produced 89 per cent, surface placers 6 per cent, drift mines 3 per cent, and hydraulic mines 2 per cent of the silver yield of placer mines.

"The production of silver from deep mines was 3,538,443 ounces, a decrease of only 695 ounces, but of 18 per cent in value, as compared with 1923, the decrease in value of course being attributable to the lower price of silver. In 1924 silver ores, practically all from San Bernardino County, yielded 65 per cent, copper ores 25 per cent, lead ores only 5 per cent, and gold ores 4 per cent of the total silver produced in the State. Smelters recovered 96 per cent of the silver yield, three-fourths of which was from smelting silver and copper concentrates. The recovery of silver at gold and silver mills was over 3 per cent of the total, a little over half of the recovery being by amalgamation."

The distribution of the 1924 silver yield, by counties, was as follows:

Silver Production by Counties, 1924.

County	Fine ounces	Value	County	Fine ounces	Value
Amador	27,240	$18,251	Nevada	58,585	$39,252
Butte	3,161	2,118	Placer	797	534
Calaveras	11,139	7,463	Plumas	369,506	247,569
El Dorado	228	153	Riverside	867	581
Fresno	283	190	Sacramento	2,617	1,753
Humboldt	10	7	San Bernardino	2,285,967	1,531,598
Imperial	2	1	San Diego	145	97
Inyo	172,834	115,799	Shasta	512,541	343,402
Kern	53,585	35,902	Sierra	7,758	5,198
Lassen	65	44	Siskiyou	442	296
Los Angeles	8,232	5,515	Stanislaus	1,154	773
Madera	262	176	Trinity	16,320	10,934
Mariposa	2,400	1,608	Tuolumne	1,651	1,106
Merced	2	1	Yuba	6,658	4,461
Mono	9,660	6,472	Alpine, Orange*	1,042	698
Totals				3,555,153	$2,381,952

*Combined to conceal output of a single operator in each.

Silver Production of California, by Years.

The value of the silver produced in California each year since 1880 has been as follows. the data previous to 1887 being taken from the reports of the Director of the Mint. There are no data available for the years previous to 1880:

Year	Value	Year	Value
1880	$1,140,556	1903	$517,444
1881	750,000	1904	873,525
1882	845,000	1905	678,494
1883	1,460,000	1906	817,830
1884	(a) 4.185,101	1907	751,646
1885	2,568,036	1908	873,057
1886	1,610,626	1909	1,091,092
1887	1,632,004	1910	993,646
1888	1,700,000	1911	673,336
1889	1,065,281	1912	799,584
1890	1,060,613	1913	832,553
1891	953,157	1914	813,938
1892	463,602	1915	851,129
1893	537,158	1916	1,687,345
1894	297,332	1917	1,462,955
1895	599,790	1918	1,427,861
1896	422,464	1919	1,240,051
1897	452,789	1920	1,859,896
1898	414,055	1921	3,629,223
1899	504,012	1922	3,100,065
1900	(b) 724,500	1923	2,918,743
1901	(b) 571,849	1924	2,381,952
1902	616,412		
		Total value	$54,849,702

[a] Lawver, A. M., in Production of Precious Metals in United States: Report of Director of Mint, 1884, p. 175; 1885.
[b] Recalculated to 'commercial' from 'coining value,' as originally published.

TIN.

Bibliography: Reports XV, XVII, XVIII. Bulletins 67, 91.

Tin is not at present produced in California; but during 1891–1892, there was some output from a small deposit near Corona, in Riverside County, as tabulated below. Small quantities of stream tin have been found in some of the placer workings in northern California, but never in paying amounts.

Two occurrences have also been noted, in northern San Diego County. Crystals of cassiterite were found there, associated with blue tourmaline crystals, amblygonite and beryl. No commercial quantity has been developed, only small pockets have been taken out.

The principal sources of the world's supply of tin are the islands of Banka, Billiton and Singkep, Netherlands India (Dutch East Indies), followed by the Federated Malay States (Perak, Pahang, Negri Sembilan and Selangor). Bolivia, Siam, Cornwall, Transvaal, New South Wales, Queensland and Tasmania are also important sources. A measurable amount of the metal is also recovered by de-tinning scrap and old cans.

Total Output of Tin in California.

Year	Pounds	Value
1891	125,289	$27,564
1892	126,000	32,400
Totals	251,289	$59,964

TUNGSTEN.

Bibliography: Reports XV, XVII, XVIII. Bulletins 38, 67, 91, 95. U. S. G. S. Bull. 652. Proc. Colo. Sci. Soc. Vol. XI. South Dakota School of Mines, Bulletin No. 12. Eng. and Min. Jour.-Press, Vol. 113, pp. 666–669, Apr. 22, 1922.

The commercial production of tungsten ores and concentrates in California began in 1905; and has been continuous since, with the exception of 1920–1922 (inclusive), when the mines were shut down owing to low prices due to excess stocks following the war and to lack of tariff protection against foreign importations. Production was resumed on a small scale late in 1923. For 1924, a total of 705 tons of all grades, or 781 tons recalculated to 60% WO_3 was shipped, valued at $446,009, being an increase over the 34 tons and $19,126 of 1923. The material shipped in 1924 included both high-grade sorted ore and concentrates, coming from properties in Inyo and San Bernardino counties. The increased yield for 1924 was due mainly to the operations of leasers on the ground of the Atolia Mining Company.

Prices in 1924 varied around $9.00 to $10.00 per unit of WO_3 for high-grade schoelite. The present quotations (September, 1925) are ranging from $11.50 to $12.50 (each 1% of WO_3).

Tungsten ore has been produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern counties, followed by the Bishop district in Inyo County, with small amounts coming from Nevada County and from the district near Goffs, in eastern San Bernardino. Most of the California tungsten ore is scheelite (calcium tungstate), though wolframite (iron-manganese tungstate) and hübernite (manganese tungstate) also occur. The deposits at Atolia are the largest and most productive scheelite deposits known,[1] and the output has in some years equaled or exceeded that of ferberite (iron tungstate) from Boulder Canyon, Colorado. It is interesting in this connection to note that, in practically all other tungsten producing districts of the world, wolframite is the important constituent.

Imports of foreign tungsten ore and alloys into the United States during 1924 amounted to 79,595 pounds, valued at $24,981, compared with 615,261 pounds valued at $215,580 in 1923, and 10,362 long tons of ore valued at $11,409,237 in 1918, which ores were duty free up to September 22, 1922. Owing to lack of protection against the cheap coolie labor of Asiatic tungsten mines, and the low market prices, practically all of the tungsten mines in the United States were closed down from the middle of 1919 to the latter part of 1923. Quotations during 1922 ranged around $2.50 per unit, up to September. The Tariff Act of 1922 placed a duty on tungsten ore or concentrates of 45¢ per pound on the metallic tungsten contained therein. Duties are also provided for imported tungsten-bearing alloys.

Uses.

The metal, tungsten, is used mainly in the steel industry and in the manufacture of electrical appliances, including the well-known tungsten filament lamps. Because of its resistance to corrosion by acids, it

[1] U. S. G. S., Bull. 652, p. 32.

is valuable in making certain forms of chemical apparatus. Its employment in tool-steel alloys, permits the operation of cutting tools, such as in lathe work, at a speed and temperature at which carbon steel would lose its temper—hence the name 'high speed' steels for these tungsten alloys. As made in the United States, tungsten forms 13% to 20% of such steels. Some chromium, nickel, cobalt, or vanadium are sometimes also included. Tungsten compounds are used in the manufacture of colors.

Tungsten is introduced into the molten steel charge, either as the powdered metal or as ferro-tungsten (containing 50%–85% tungsten). The specific gravity of the pure metal, 19.3–21.4, is exceeded only by platinum, 21.5; iridium, 22.4; and osmium, 22.5. Its melting point is 3267° C. (5913° F.), being higher than any other known metal. Though millions of tungsten filament lamps are now made, the wires are so fine that the metal they contain represents but a few tons of tungsten concentrates annually.

Total Tungsten Ore Production of California.

The annual amount and value of tungsten ores and concentrates produced in California since the inception of the industry is given herewith, with tonnages recalculated to 60% WO_3:

Year	Tons at 60% WO_3	Value	Year	Tons at 60% WO_3	Value
1905	57	$18,800	1915	962	$1,005,467
1906	485	189,100	1916	2,270	4,571,521
1907	287	120,587	1917	2,466	3,079,013
1908	105	37,750	1918	1,982	2,832,222
1909	577	190,500	1919	214	219,316
1910	457	208,245	1920	----------	----------
1911	387	127,706	1923	34	19,126
1912	572	206,000	1924	781	446,009
1913	559	234,673	Totals	12,615	$13,686,610
1914	420	$180,575			

VANADIUM.

Bibliography: Report XV. Bulletins 67. 91. Proc. Colo. Sci. Soc., Vol. XI. U. S. Bur. of Mines, Bulletin 104.

No commercial production of vanadium has yet been made in California. Occurrences of this metal have been found at Camp Signal, near Goffs, in San Bernardino County, and two companies at one time did considerable development work in the endeavor to open up paying quantities. Each had a mill under construction in 1916, but apparently no commercial output was made. Ore carrying the mineral cuprodescloizite and reported as assaying 4% V_2O_5 was opened up. Some ore carrying lead vanadate has been developed in the 29 Palms, or Washington district, on the line between Riverside and San Bernardino counties, but no shipments reported.

The principal use of vanadium is as an alloy in steels, especially in tool steel, and in those varieties where resistance to repeated strains is required. Present New York quotations for vanadium ore are @ $1.00–$1.25 per pound of contained V_2O_5 (guaranteed minimum of 18% V_2O_5).

ZINC.

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII. Bulletins 38, 67, 91.

Recoverable zinc in ores mined in California in 1924 amounted to 3,060,000 pounds, valued at $198,900, and was marketed entirely in the form of the oxide. The average price per pound quoted for the metal in 1924 was 6.5¢. There was no recoverable zinc mined in California in 1923.

The zinc ores of Shasta and Calaveras counties are associated with copper, while those of Inyo and San Bernardino are associated principally with lead-silver and zinc-silver ores.

The principal uses of zinc are for 'galvanizing' (plating on iron to prevent rust), for zinc oxide (used in rubber goods and paint), and for brass (an alloy of copper and zinc). These outlets for the metal take approximately 80% of the quantity produced. Of the remaining 20% a large portion is rolled into plates and sheets, and utilized in the building industry for sheathing, roofing, leaders, and eaves-troughs. Zinc is particularly desirable and efficient for roofing and siding where corrosive gases are present, as at smelters, refineries and chemical plants.

Total Zinc Production of California.

Total figures for zinc output of the state are as follows, commercial production dating back only to 1906:

Year	Pounds	Value	Year	Pounds	Value
1906	206,000	$12,566	1916	15,950,565	$2,137,375
1907	177,759	10,598	1917	11,854,804	1,209,190
1908	54,000	3,544	1918	5,565,561	506,466
1909			1919	1,384,192	101,046
1910			1920	1,188,009	96,229
1911	2,679,842	152,751	1921	846,184	42,309
1912	4,331,391	298,866	1922	3,034,430	172,963
1913	1,157,947	64,845	1923		
1914	399,641	20,381	1924	3,060,000	198,900
1915	13,043,411	1,617,383	Totals	64,933,736	$6,645,412

CHAPTER FOUR.

STRUCTURAL MATERIALS.

Bibliography: State Mineralogist Reports XII–XXI (inc.) Bulletin 38. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

As indicated by this subdivision heading, the mineral substances herein considered are those more or less direectly used in building and structural work. California is independent, so far as these are concerned, and almost any reasonable construction can be made with materials produced in the state. This branch of the mineral industry for 1924 was valued at $51,310,197 as compared with a total value of $53,782,362 for the year 1923, the decrease being due mainly to a lower price for cement.

Deposits of granite, marble and other building stones are distributed widely throughout this state, and transportation and other facilities are gradually being extended so that the growing demand may be met. The largest single item, cement, has had an interesting record of growth since the inception of the industry in California about 1891. Not until 1904 did the annual value of cement produced reach the million-dollar mark, following which it increased 500% in nine years; though from 1914 to 1918 there was a falling off common to all building materials. The 1924 output establishes a new high-level mark, in quantity, but the value dropped below that of 1923.

Crushed rock production is yearly becoming more worthy of consideration, due to the strides recently taken in the use of concrete, as well as to activity in the building of good roads. Brick, with an average annual output for a number of years worth approximately $2,000,000, had difficulty in holding its own, due to the popularity of cement and concrete. In 1920, however, the sales increased to nearly double the previous record figure of the year 1907, and in 1923 showed advances to new figures, with a slight recession in 1924. This item will, no doubt, continue to be an important one, and a market for fire and fancy brick of all kinds will unquestionably never be lacking.

Fifty-six counties contributed to this structural total for 1924, and there is not a county in the state which is not capable of some output of at least one of the materials under this classification.

The following summary shows the value of the structural materials produced in California during the years 1923–1924 with increase or decrease in each instance:

Substance	1923		1924		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Bituminous rock	2,945 tons	$11,780	6,040 tons	$14,922	$3,142+
Brick and hollow tile		9,738,082		9,137,908	600,174—
Cement	10,825,405 bbls.	25,999,203	11,655,131 bbls.	23,225,850	2,773,353—
Chromite	84 tons	1,658	350 tons	6,700	5,042+
Granite		760,081		1,211,046	450,965+
Lime	70,894 tons	788,834	62,029 tons	703,355	85,479—
Magnesite	73,963 tons	946,643	67,236 tons	900,183	46,460—
Marble	28,015 cu. ft.	124,919	[a]61,579 cu. ft.	140,253	15,334+
Onyx and travertine	14,220 cu. ft.	2,510	[b]		+
Sandstone	7,000 cu. ft.	13,000	6,700 cu. ft.	3,600	9,400—
Stone, miscellaneous		15,395,652		15,966,380	570,728+
Total value		$53,782,362		$51,310,197	
Net decrease					$2,472,165—

[a]Includes onyx and travertine.
[b]Combined with marble.

ASPHALT.

Bibliography: State Mineralogist Reports VII, X, XII–XV (inc.), XVII, XVIII. Bulletins 16, 32, 63, 67, 69, 91.

Asphalt was for a number of years accounted for in the statistical reports by the State Mining Bureau, because in the early days of the oil industry, considerable asphalt was produced from outcroppings of oil sand, and was a separate industry from the production of oil itself. However, at the present time most of the asphalt comes from the oil refineries, which produce a better and more uniform grade; hence, its value is not now included in the mineral total, as to do so would be in part a duplication of the crude petroleum figures. Such natural asphalt as is at present mined is in the form of bituminous sandstones, and is recorded under that designation.

BITUMINOUS ROCK.

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII.

Small amounts of bituminous rock are still occasionally used for road dressing in those districts adjacent to available deposits, though the manufacture of asphalt at the oil refineries has almost eliminated the direct use of the native material. During 1924, a total of 6,040 tons valued at $14,922 was shipped from quarries in Santa Barbara and Santa Cruz counties, compared with 2,945 tons and $11,780 in 1923.

This material is essentially an uncemented sandstone which is saturated with and held together by a natural asphaltic constituent probably the residue from the evaporation of a crude petroleum deposit.

Bituminous Rock Production of California, by Years.

The following tabulation shows the total amount and value of

bituminous rock quarried and sold in California, from the records compiled by the State Mining Bureau, annually since 1887:

Year	Tons	Value	Year	Tons	Value
1887	36,000	$160,000	1907	24,122	$72,835
1888	50,000	257,000	1908	30,718	109,818
1889	40,000	170,000	1909	34,123	116,436
1890	40,000	170,000	1910	87,547	165,711
1891	39,962	154,164	1911	75,125	117,279
1892	24,000	72,000	1912	44,073	87,467
1893	32,000	192,036	1913	37,541	78,479
1894	31,214	115,193	1914	66,119	166,618
1895	38,921	121,586	1915	17,789	61,468
1896	49,456	122,500	1916	19,449	66,561
1897	45,470	128,173	1917	5,590	18,580
1898	46,836	137,575	1918	2,561	9,067
1899	40,321	116,097	1919	4,614	18,537
1900	25,306	71,495	1920	5,450	27,825
1901	24,052	66,354	1921	8,298	43,192
1902	33,490	43,411	1922	4,624	13,570
1903	21,944	53,106	1923	2,945	11,780
1904	45,280	175,680	1924	6,040	14,922
1905	24,753	60,436			
1906	16,077	45,204	Totals	1,181,810	$3,632,155

BRICK and HOLLOW TILE.

Bibliography: State Mineralogist Reports VIII, X, XII–XV (inc.), XVII–XXI (inc.). Bulletin 38. Preliminary Report, No. 7. Cal. Jour. of Development, June, 1925, pp. 5–6.

Bricks of many varieties and in important quantities are annually produced in California, as might be expected in a state with such diversified and widespread mineral resources. The varieties include common, fire, pressed, glazed, enamel, fancy, vitrified, sand-lime, and others. Not only do the plants here supply practically all of our own requirements in these products, but considerable quantities are shipped to contiguous territory and certain products are shipped over a much wider radius. So far as possible, the different kinds have been segregated in the tabulation herewith accompanying.

We also include under this heading the various forms of hollow building 'tile' or blocks. The application of these tile to residence construction as well as to other structures is growing; though their total for 1924 shows a slight drop from the record figure of 1923.

The aggregate value of all kinds of brick in 1924 shows a decrease of approximately 6% from the high-level of 1923, due mainly to a drop in the sales of common brick in the Los Angeles district. The total of glazed, pressed, fancy, vitrified, paving, and sand-lime brick showed an important increase; while fire-brick held its own. In spite of the decrease in sales of common in Los Angeles, the total of common for 1924 in that county still (as in 1922–1923) exceeded the entire state's total of common brick for the year 1921 (202,417 M and $2,880,124). This item, of itself, is an indication of the continued activity in construction operations during the past year. This, too, even in the face of the increasing use of reinforced concrete in structural building, throughout the state.

The detailed figures of brick and tile production for 1924, by counties, are given in the following tabulation. 'Production' in this case means *sales* of product of California manufacture; and 'value' is *net price* at the works, f. o. b. cars, trucks or boats.

Brick and Hollow Tile Production for 1924, by Counties.

County	Common		Fire		Glazed, pressed, fancy, vitrified, paving		Hollow building tile or blocks		Total value
	Amount, M	Value	Amount, M	Value	Amount, M	Value	Tons	Value	
Alameda	*		2,634	$141,646	5,582	$230,789	*		$372,435
Los Angeles	265,849	$3,153,224	8,731	556,918	[ab]27,377	1,320,117	46,941	454,728	5,484,987
Mendocino	550	7,125							7,125
Orange	3,884	39,260			*				39,260
Santa Clara	24,271	217,172							217,172
Alameda, Contra Costa, Fresno, Humboldt, Imperial, Kern, Marin, Merced, Riverside, Sacramento, San Diego, San Joaquin, San Luis Obispo, Tehama, Tulare*	80,856	965,375							965,375
Amador, Contra Costa, Fresno, Placer, Riverside, Sacramento, San Diego, San Joaquin, San Luis Obispo[d]*			17,322	893,053					893,053
Contra Costa, Fresno, Orange[c], Placer, Riverside, Sacramento, San Diego, Santa Barbara*					14,660	459,786			459,786
Alameda, Contra Costa, Fresno, Merced, Placer, Riverside, Sacramento, San Diego, Santa Barbara, Tulare*							67,528	698,715	698,715
Totals	375,410	$4,382,156	28,687	$1,591,617	52,619	$2,010,692	114,469	$1,153,443	$9,137,908

*Combined to conceal output of a single operator in each.
[a]Includes 'segment blocks.'
[b]Includes 'Ferguson blocks.'
[c]Sand-lime brick.
[d]Includes insulating brick.

Brick and Hollow Tile Production of California, by Years.

Record of brick production in the state has been kept since 1893 by this Bureau, the figures for hollow building 'tile' or blocks being also included since 1914. The annual and total figures, for amount and value, are given in the following table:

Year	Brick, M	Hollow building blocks, tons	Value
1893	103,900		$801,750
1894	81,675		457,125
1895	131,772		672,360
1896	24,000		524,740
1897	97,468		563,240
1898	100,102		571,362
1899	125,950		754,730
1900	137,191		905,210
1901	130,766		860,488
1902	169,851		1,306,215
1903	214,403		1,999,546
1904	281,750		1,994,740
1905	286,618		2,273,786
1906	277,762		2,538,848
1907	362,167		3,438,951
1908	332,872		2,506,495
1909	333,846		3,059,929
1910	340,883		2,934,731
1911	327,474		2,638,121
1912	337,233		2,940,290
1913	358,754		2,915,350
1914	270,791		2,288,227
1915	180,538		1,678,756
1916	206,960		2,096,570
1917	192,269	29,348	2,532,721
1918	136,374	34,818	2,363,481
1919	156,328	36,026	3,087,067
1920	245,842	99,208	5,704,393
1921	238,022	67,100	5,570,875
1922	374,853	105,909	7,994,991
1923	397,754	122,534	9,738,082
1924	456,716	114,469	9,137,908
Totals	7,412,884	609,412	$88,851,078

CEMENT.

Bibliography: State Mineralogist Reports VIII, IX, XII, XIV, XV, XVII, XVIII, XXI, Bulletin 38.

Cement is the most important single structural material in the mineral output of this state. During 1924, there was produced a total of 11,655,131 barrels, valued at $23,225,850 f. o. b. plant. This is an increase of 829,726 barrels over the previous record figure of 10,825,405 barrels in 1923; but a decrease of $2,773,353 from the 1923 value of $25,999,203. The lower sales prices prevailing in 1924 were due to the competition of foreign cements brought over in ballast and dumped onto our local markets duty-free. There is no import duty on this foreign cement, the bulk of which came from Belgium.

As in the preceding three years, the output came from nine operating plants in seven counties, and in 1924 employing a total of 3081 men. The three plants in San Bernardino County made a total of 4,354,119 barrels valued at $7,571,370, the balance of the state's product coming

collectively from a single plant in each of the following counties: Contra Costa, Kern, Riverside, San Benito, Santa Cruz, and Solano. For 1925, the new plant of the Pacific Portland Cement Company at Redwood City, San Mateo County, is operating and utilizing marine shells as a source of calcium carbonate. The Yosemite Portland Cement Company is building a plant at Merced, and will use limestone from a deposit on the Merced River in Mariposa County.

According to reports of the U. S. Geological Survey, California ranks third as a cement producer, being surpassed only by Pennsylvania and Indiana; but our net increase in the period 1910–1923 (inc.) has been exceeded only by Pennsylvania. In per capita consumption, how-

State highway bridge over the Sacramento River at Dunsmuir, Siskiyou County, showing use of California cement and crushed rock in a reinforced concrete structure.

ever, California leads all others with an average in 1923 of 2.69 barrels as against the average of 1.21 barrels for the entire United States.

Cement Production of California, by Years.

'Portland' cement was first commercially produced in California in 1891; though in 1860 and for several years following, a natural hydraulic cement from Benicia was utilized in building operations in San Francisco.

[1] "The Benicia Cement Company in 1859–60 was turning out 50 to 100 barrels of cement a day and San Francisco was using about 12,000 barrels a year. The mill price of the product was then $4 a barrel. By 1865, the San Francisco rate of consumption had increased to 100,000 barrels yearly, brick buildings largely taking

[2] Monthly Review, of Mercantile Trust Co. of Cal., Vol. XIII, No. 3, p. 55, Mar. 1924.

the place of frame structures, and the price of cement had fallen to $2.50 a barrel, about the same as it is today."

The growth of the industry became rapid after 1902; since which time cement has continued to be an important factor in the industrial life of the state. Although the total cement figures, to date, are not of the same magnitude as those for gold and petroleum, it is interesting to note that the value of California's cement yield beginning with 1920 has since annually exceeded the value of her gold output.

Annual production of cement in California has been as follows:

Year	Barrels	Value	Year	Barrels	Value
1891	5,000	$15,000	1909	3,779,205	$4,969,437
1892	5,000	15,000	1910	5,453,193	7,485,715
1893			1911	6,371,369	9,085,625
1894	8,000	21,600	1912	6,198,634	6,074,661
1895	16,383	32,556	1913	6,167,806	7,743,024
1896	9,500	28,250	1914	5,109,218	6,558,148
1897	18,000	66,000	1915	4,918,275	6,044,950
1898	50,000	150,000	1916	5,299,507	6,210,293
1899	60,000	180,000	1917	5,790,734	7,544,282
1900	52,000	121,000	1918	4,772,921	7,969,909
1901	71,800	159,842	1919	4,645,289	8,591,990
1902	171,000	423,600	1920	6,709,160	14,962,945
1903	640,868	968,727	1921	7,404,221	18,072,120
1904	969,538	1,539,807	1922	8,962,135	16,524,056
1905	1,265,553	1,791,916	1923	10,825,405	25,999,203
1906	1,286,000	1,941,250	1924	11,655,131	23,225,850
1907	1,613,563	2,585,577			
1908	1,629,615	2,359,692	Totals	111,934,023	$189,462,015

CHROMITE.

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV, XVII, XVIII, XXI. Bulletins 38, 76, 91. Preliminary Report 3. U. S. G. S., Bull 430. Min. & Sci. Press, Vol. 114, p. 552.

Chromic iron ore, or chromite, to the amount of 350 short tons, recalculated to a basis of 45% Cr_2O_3, valued at $6,700 f.o.b. rail-shipping point was sold in California during the year 1924. This was principally of ore that had been mined during the World War period, but not then sold. It is hoped that the development of the steel industry and the resumption of copper smelting on the Palific Coast may create some demand for California's chromite, but the outlook for the immediate future is not encouraging.

Occurrence.

Until 1916, when some shipments were made from Oregon and smaller amounts from Maryland, Wyoming and Washington, practically our only domestic production of chromite for many years came

from California. From 1820 to 1860 the deposits in Pennsylvania and Maryland supplied the world's consumption.

Chromite is widely distributed in California, the principal production, thus far, having come from El Dorado, San Luis Obispo, Del Norte, Shasta, Siskiyou, Placer, Fresno, and Tuolumne counties. In 1918 a total of 29 counties contributed to the state's output. There are two main belts in California yielding this mineral, one along the Coast Ranges from San Luis Obispo County to the Oregon line, including the Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous rocks such as peridotite and pyroxenite, and in serpentines which have been derived by alteration of such basic rocks. For the most part, so far as developments have yet shown, the lenses have proved to be small, relatively few of them yielding over 100 tons apiece. A notable exception to this was the deposit on Little Castle Creek, near Dunsmuir, from which upwards of 15,000 tons was shipped before it was exhausted. Deposits worked in Del Norte County during 1918 promised well for a large tonnage. On the whole the orebodies in the northwestern corner of the state appear to average larger in size than the chromite lenses in other parts of California.

Concentration became an accomplished fact in several localities, thus utilizing some of the disseminated and lower-grade orebodies which have been found. In fact, an important part of the 1918–1920 production came from that source.

Imports.

Importations of foreign chromite, duty free, mainly from Rhodesia, New Caledonia, and India, totaled 118,343 long tons in 1924, valued at $1,095,603, compared with 128,763 tons and $1,123,120 in 1923.

Uses.

The major consumption of chromite ore is for use as a refractory lining in smelting furnaces for steel and copper. A smaller portion is used in the preparation of ferro-chrome for chrome-steel alloys, and of chromium chemicals.

Total Chromite Production of California.

Production of chromite in California began, apparently, about 1874, principally in San Luis Obispo County. There was considerable activity from 1880 to 1883, inclusive, and a total of 23,238 long tons (or 26,028 short tons), valued at $329,924 was shipped from that county up to the beginning of 1887. Some ore also was shipped from the Tyson properties in Del Norte County. The tabulation herewith shows the output of chromite in California, annually, including the

earliest figures so far as they are available. The figures from 1887 to date are from the records of the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1874–1886 (San Luis Obispo Co.)	26,028	$329,924	1906	317	$2,859
1887	3,000	40,000	1907	302	6,040
1888	1,500	20,000	1908	350	6,195
1889	2,000	30,000	1909	436	5,309
1890	3,599	53,985	1910	749	9,707
1891	1,372	20,580	1911	935	14,197
1892	1,500	22,500	1912	1,270	11,260
1893	3,319	49,785	1913	1,180	12,700
1894	3,680	39,980	1914	1,517	9,434
1895	1,740	16,795	1915	3,725	38,044
1896	786	7,775	1916	48,943	717,244
1897			1917	52,379	1,130,298
1898			1918	73,955	3,649,497
1899			1919	*4,314	97,164
1900	140	1,400	1920	1,770	43,031
1901	130	1,950	1921	347	6,870
1902	315	4,725	1922	379	6,334
1903	150	2,250	1923	84	1,658
1904	123	1,845	1924	350	6,700
1905	40	600	Totals	242,724	$6,119,185

*Recalculated to 45% Cr_2O_3, beginning with 1919.

GRANITE.

Bibliography: State Mineralogist Reports, X, XII–XXI (inc.). Bulletin 38.

The value of the granite output of California for 1924 was the highest recorded for any year since 1891, due mainly to the contract for the construction of the new Los Angeles County Building. Stone for 'monumental' and decorative purposes showed an increase in quantity but a decrease in total value. The net result was an increase in total value of the several groups from $760,081 to $1,211,046. We have included under this heading some rhyolite and tuff utilized for dimension building stone, as we have no other dimension stone grouping for statistical purposes in this report except marble and sandstone.

Crushed rock, rubble, and paving blocks derived from granite quarries are given under the heading of 'Miscellaneous Stone.'

So far as possible, granite production has been segregated in the table herewith into the various uses to which the product was put. It will be noted, however, that a portion of the output has been entered under the heading 'unclassified.' This is necessary because of the fact that some of the producers have no way of telling to what specific use their stone was put after they had quarried and sold the same in the rough.

Varieties.

For building purposes, the granites found in California, particularly the varieties from Raymond in Madera County, Rocklin in Placer County, and near Porterville in Tulare County, are unexcelled by any similar stone found elsewhere. The quantities available, notably at

Raymond and Porterville, are unlimited. Most of California's 'granite,' particularly that found in the Sierra Nevada Mountains, is technically 'granodiorite' (that is, both plagioclase and orthoclase feldspars are present).

Granites of excellent quality for building and ornamental purposes are also quarried in Riverside and San Diego counties. Near Lakeside, San Diego County, there is a fine-grained, 'silver gray' granite of uniform texture and color, especially suited for monumental and ornamental work.

The Fresno County stone is a dark, hornblende diorite, locally called 'black granite,' whose color permits of a fine contrast of polished and unpolished surfaces, making it particularly suitable for monumental and decorative purposes. There is also a similar 'black granite' in Tulare County, near Success.

Granite Production by Counties for 1924.

County	Building stone		Monumental		Curbing		Unclassified		Total value
	Cubic feet	Value	Cubic feet	Value	Linear feet	Value	Cubic feet	Value	
Fresno			14,405	$60,447					$60,447
Madera	387,647	$746,795	81,665	161,829			13,598	$27,196	935,820
Placer	1,678	7,982	3,770	10,054			678	1,119	19,155
Riverside	4,600	5,900	3,740	11,780					17,680
Sacramento	2,500	10,100	75	150	*		[b]150	600	10,850
San Diego	1,700	4,950	24,124	89,056					94,006
Inyo[a], Los Angeles[a] Plumas, Tulare*	61,347	44,215							44,245
Nevada, Plumas, Tulare, Tuolumne*			3,282	27,343					27,343
Nevada, Sacramento*					500	1,500			1,500
Totals	459,472	$819,972	131,061	$360,659	500	$1,500	14,426	$28,915	$1,211,046

*Combined to conceal output of a single operator in each.
[a]Includes tuff used for building stone.
[b]Includes flagging.

Granite Production of California, by Years.

The value of granite produced, annually, since 1887, has been as follows:

Year	Value	Year	Value
1887	$150,000	1907	$373,376
1888	57,000	1908	512,923
1889	1,329,018	1909	376,834
1890	1,200,000	1910	417,898
1891	1,300,000	1911	355,742
1892	1,000,000	1912	362,975
1893	531,322	1913	981,277
1894	228,816	1914	628,786
1895	224,329	1915	227,928
1896	201,004	1916	535,339
1897	188,024	1917	221,997
1898	147,732	1918	139,861
1899	141,070	1919	220,743
1900	295,772	1920	495,732
1901	519,285	1921	725,901
1902	255,239	1922	676,643
1903	678,670	1923	760,081
1904	467,472	1924	1,211,046
1905	353,837		
1906	344,083	Total value	$18,837,755

Summit Lime Plant of Union Lime Company, at Tehachapi, Kern County.

LIME.

Bibliography: Reports XIV, XV, XVII, XVIII. Bulletin 38.

Lime to the amount of 62,029 tons, valued at $703,355, was produced by eleven plants in eight counties during 1924, as compared with 70,894 tons valued at $788,834 in 1923. There were two plants each, in Kern, San Bernardino, and Santa Cruz counties, and one each in El Dorado, Inyo, San Diego, Siskiyou, and Tuolumne.

So far as we have been able to segregate the data, these figures include mainly only such lime as is used in building operations; though they do include a small proportion of calcined lime employed in agriculture and the chemical industries, the figures for which were not separable. A portion is hydrated lime. Limestone utilized in sugar making, for smelter flux, as a fertilizer, and other special industrial uses, are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

Lime Production of California, by Years.

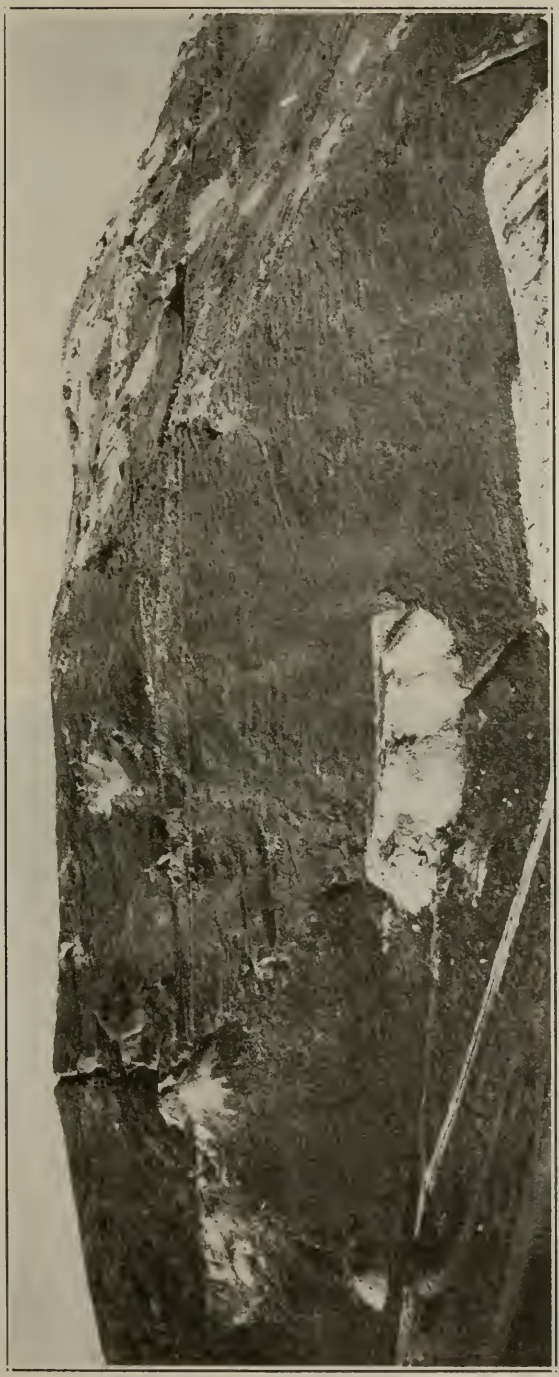
The following tabulation gives the amounts and value of lime produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1894	37,350	$318,700	1910	47,951	$477,683
1895	39,776	386,094	1911	42,959	390,988
1896	30,275	261,505	1912	52,212	464,440
1897	28,780	252,900	1913	61,344	528,547
1898	29,786	254,010	1914	43,996	378,663
1899	29,985	314,575	1915	35,653	286,304
1900	31,252	283,699	1916	49,364	390,475
1901	31,738	334,688	1917	50,073	311,380
1902	44,866	369,616	1918	43,684	461,315
1903	49,659	418,280	1919	42,070	552,043
1904	57,945	571,749	1920	46,314	557,232
1905	61,700	555,322	1921	46,353	610,619
1906	68,927	763,060	1922	57,875	671,747
1907	68,422	756,376	1923	70,894	788,834
1908	39,639	379,243	1924	62,029	703,355
1909	52,075	577,824			
			Totals	1,454,946	$14,371,266

MAGNESITE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XX. Bulletins 38, 79. U. S. Geol. Surv., Bulletins 355, 540: Min. Res. 1913, Pt. II, pp. 450–453. Min. & Sci. Press, Vol. 114, p. 237. "Magnesite"—Hearings before the Comm. on Ways and Means, House of Repr., on H. R. 5218, June 16, 17 and July 17, 1919. Eng. Soc. W. Penn., Proc. 1913, Vol. 29, pp. 305–388, 418–444. Eng. & Min. Jour-Press, Vol. 114, July 29, and Dec. 2, 1922.

The production of magnesite in California during 1924 amounted to a total of 67,236 tons of crude ore valued at $900,183. Only a small part of it was sold 'crude,' however, as it is practically all shipped in the calcined form. The reports at hand show a total of 29,235 tons shipped calcined, of which 2925 tons were dead-burned and sold for refractory purposes, the balance going to the plastic trade. From 2 to 2½ tons of crude material are mined to make one ton of calcined. The 1924 output is a slight decrease both in quantity and value from the 1923 figures of 73,963 tons crude valued at $946,643. The average of the values reported for 1924 is $13.40 per ton as against $12.80 in 1923.



Southerly side of 'north' hill (Harker Mine) from the south, showing both 'gash' and 'blanket' veins, near Porterville, Tulare County.

Magnesite specimen showing conchoidal fracture. From No. 4 Tunnel, Tulare Mine of Sierra Magnesite Company, near Success, Tulare County. Two-thirds natural size.

Magnesite specimen showing conchoidal fracture. From Stanislaus County. Two-thirds natural size.

The more important producing properties in 1924 were: Maltby No. 1 (Western Magnesite Development Co., operated under lease by C. S. Maltby), on Red Mountain, Santa Clara County; and the Sierra Magnesite Company's group near Porterville, Tulare County; followed in order by the Sampson Peak Mine (Maltby No. 3), San Benito County; California Magnesia Company (old Harker mine) at Porterville; and Maltby No. 2 in Chiles Valley, Napa County. Lesser amounts were reported mined in Fresno and Stanislaus counties.

Detailed descriptions of these mines and plants are given by the writer[1] in Bulletin No. 79 of the State Mining Bureau, recently published.

On the whole, the magnesite industry is in a fairly satisfactory condition; the market is firm, and the use of this material, particularly the plastic form, is increasing on the Pacific Coast. Because of high freight rates, California is at a disadvantage competing in the Atlantic sea-board states with foreign importations, but can at least hold its own as far east as the Mississippi River, under present conditions.

Occurrence.

Magnesite is a natural carbonate of magnesium, and when pure contains 52.4% CO_2 (carbon dioxide) and 47.6% MgO (magnesia). It has a hardness of 3.5 to 4.5, and specific gravity of 3 to 3.12. It is both harder and heavier than calcite (calcium carbonate), and also contains a higher percentage of CO_2 as calcite has but 44%.

Most of the California magnesite is comparatively pure, and is ordinarily a beautiful, white, fine-grained rock with a conchoidal fracture resembling a break in porcelain. The Grecian magnesite is largely of this character; but the Austrian varieties usually contain iron, so that they become brown after calcining. The Washington magnesite resembles dolomite and some crystalline limestones in physical appearance. Its color varies through light to dark gray, and pink.

In California the known deposits are mostly in the metamorphic rocks of the Coast Ranges and Sierra Nevada Mountains, being associated with serpentine areas. The notable exceptions are the sedimentary deposits, at Bissell in Kern County and at Afton in San Bernardino County. Several thousand tons have been shipped from the Bissell deposit; and small shipments have been made from the Afton property.

The Washington deposits are associated with extensive strata of dolomitic limestone. The magnesite there appears to contain more iron than most of the California mineral, which makes it desirable for the steel operators. However, recent experience has proved that several California localities have sufficient iron in their magnesite to be serviceable in the steel furnaces. This is particularly true of the Refractory Magnesite Company's mine near Preston in Sonoma County, the White Rock Mine at Pope Valley and the Blanco Mine in Chiles Valley, Napa County. There is some also at the Sampson Peak property in San Benito County.

Uses.

The principal uses include: Refractory linings for basic open-hearth steel furnaces, copper reverberatories and converters, bullion and other

[1]Bradley, W. W., Magnesite in California: Cal. State Min. Bur., Bull. 79, 1925.

metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for exterior stucco, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc. In connection with building work it has proved particularly efficient as a flooring for steel railroad coaches, on account of having greater elasticity and resilience than 'Portland' cement. For refractory purposes the magnesite is 'dead-burned'—*i. e.*, all or practically all of the CO_2 is expelled from it. For cement purposes it is left 'caustic'—*i. e.*, from 2% to 10% of CO_2 is retained. When dry caustic magnesite is mixed with a solution of magnesium chloride ($MgCl_2$) in proper proportions, a very strong cement is produced, known as oxychloride or Sorel cement. It is applied in a plastic form, which sets in a few hours, as a tough, seamless surface. It has also a very strong bonding power, and will hold firmly to wood, metal, or concrete as a base. It may be finished with a very smooth, even surface, which will take a good wax or oil polish. As ordinarily mixed there is added a certain proportion of wood flour, cork, asbestos, or other filler, thereby adding to the elastic properties of the finished product. Its surface is described as 'warm' and 'quiet' as a result of the elastic and nonconducting character of the composite material. The cement is frequently colored by the addition of some mineral pigment to the materials before mixing as cement.

For refractory purposes the calcined magnesite is largely made up into bricks similar to fire-brick for furnace linings. It is also used unconsolidated, as 'grain' magnesite. For such, an iron content is desirable, as it allows of a slight sintering in forming the brick. Dead-burned, pure, magnesia can not be sintered except at very high temperatures; and it has little or no plasticity, so that it is hard to handle. Its plasticity is said to be improved by using with it some partly calcined or caustic magnesite. Heavy pressure will bind the material sufficiently to allow it to be sintered.

A coating of crushed magnesite is laid on hearths used for heating steel stock for rolling, to prevent the scale formed from attacking the fire-brick of the hearth.

Imports and Domestic Production.

Reports of the U. S. Bureau of Foreign and Domestic Commerce show imports of calcined magnesite to have been 172,591 long tons in 1913; 144,747 in 1914, and 63,347 in 1915; most of it coming from Austria-Hungary and some from Greece. For the same years the production of crude (from 2 to 2½ tons of crude ore required to yield one ton of the calcined) magnesite in California (the sole producer of those years, in the United States) was: 9632 short tons, 11,438 tons, 30,721 tons, respectively. For 1916 the California output leaped to 154,052 tons of crude and to 209,648 tons in 1917, but following which it dropped considerably on account of resumption of foreign importations, which totaled 52,483 long tons in 1921, valued at $776,384 being then admitted duty free. Shipments from Washington were begun late in 1916; and during the following three years assumed important proportions.

The Tariff Act of 1922, which became effective September 22d, of that year, placed the following import duties on magnesite: Crude magnesite 3/16¢ per lb., caustic-calcined magnesite 5/8¢ per lb.; dead-

burned and grain magnesite, not suitable for manufacture into oxychloride cements, $^{25}/_{40}$¢ per lb.; magnesite brick, ¾¢ per lb. and 10% ad valorem. The figures of imports for 1924 as published by the U. S. Bureau of Foreign and Domestic Commerce, show a total of 62,862 long tons of calcined ore valued at $1,098,998, as compared with 76,813 long tons and $1,132,113 in 1923.

Total Magnesite Production of California.

The first commercial production of magnesite in California was made in the latter part of 1886 from the Cedar Mountain district,[1] southeast of Livermore, Alameda County. Shipments amounting to 'several tons' or 'several carloads' were sent by rail to New York; but there is apparently no exact record of the amount for that first year. The statistical records of the State Mining Bureau began with the year 1887, and the table herewith shows the figures for amount and value, annually, from that time. Shipments of magnesite from Napa County began in 1891 from the Snowflake Mine; from the Red Mountain deposits in Santa Clara County, in 1899; and from Tulare County in 1900.

Production of Magnesite in California, Since 1887.

Year	Tons	Value	Year	Tons	Value
1887	600	$9,000	1907	6,405	$57,720
1888	600	9,000	1908	10,582	80,822
1889	600	9,000	1909	7,942	62,588
1890	600	9,000	1910	16,570	113,887
1891	1,500	15,000	1911	8,858	67,430
1892	1,500	15,000	1912	10,512	105,120
1893	1,093	10,930	1913	9,632	77,056
1894	1,440	10,240	1914	11,438	114,380
1895	2,200	17,000	1915	30,721	283,461
1896	1,500	11,000	1916	154,052	1,311,893
1897	1,143	13,671	1917	209,648	1,976,227
1898	1,263	19,075	1918	83,974	803,492
1899	1,280	18,480	1919	44,696	452,094
1900	2,252	19,333	1920	83,695	1,033,491
1901	4,726	43,057	1921	47,837	511,102
1902	2,830	20,655	1922	55,637	594,665
1903	1,361	20,515	1923	73,963	946,643
1904	2,850	9,298	1924	67,236	900,183
1905	3,933	16,221			
1906	4,032	40,320	Totals	970,701	$9,828,049

MARBLE.

Bibliography: State Mineralogist Reports XII–XV (inc.). XVII–XXI (inc.). Bulletin 38. U. S. Bur. of Mines, Bull. 106.

Marble is widely distributed in California, and in a considerable variety of colors and grain. The 1924 figures show an increase both in quantity and value over those of 1923, but are combined with the figures for onyx and travertine to conceal output of a single operator.

California has many beautiful and serviceable varieties of marble, suitable for almost any conceivable purpose of construction or decoration. In the decorative class are deposits of onyx marble of beautiful

[1]See U. S. Geol. Surv.; Mineral Resources of U. S., 1886, pp. 6 and 696.

coloring and effects. There is also serpentine marble suitable for electrical switchboard use.

Marble Production of California, by Years.

Data on annual production since 1887, as compiled by the State Mining Bureau, follows. Previous to 1894 no records of amounts were preserved.

Year	Cubic feet	Value	Year	Cubic feet	Value
1887	----------	$5,000	1907	37,512	$118,066
1888	----------	5,000	1908	18,653	47,665
1889	----------	87,030	1909	79,600	238,400
1890	----------	80,000	1910	18,960	50,200
1891	----------	100,000	1911	20,201	54,103
1892	----------	115,000	1912	27,820	74,120
1893	----------	40,000	1913	41,654	113,282
1894	38,441	98,326	1914	25,436	48,832
1895	14,864	56,566	1915	22,186	41,518
1896	7,889	32,415	1916	25,954	50,280
1897	4,102	7,280	1917	24,755	62,950
1898	8,050	23,594	1918	[a]17,428	49,898
1899	9,682	10,550	1919	25,020	74,482
1900	4,103	5,891	1920	[b]29,531	92,899
1901	2,945	4,630	1921	30,232	98,395
1902	19,305	37,616	1922	38,321	127,792
1903	84,624	97,354	1923	28,015	124,919
1904	55,401	94,208	1924	[b]61,579	140,253
1905	73,303	129,450			
1906	31,400	75,800	Total value	----------	$2,713,764

[a]Includes onyx and serpentine.
[b]Includes onyx.

ONYX and TRAVERTINE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII, XVIII. Bulletin 38.

Onyx and travertine are known to exist in a number of places in California, but there has been only a small and irregular production since the year 1896. In 1924 there were shipments from Solano and Mono counties the figures for which are combined with marble.

Onyx Production of California, by Years.

Production by years was as follows:

Year	Value	Year	Value
1887	$900	1896	$24,000
1888	900	1918	*
1889	900	1919	----------
1890	1,500	1920	*
1891	2,400	1921	1,294
1892	1,800	1922	3,320
1893	27,000	1923	2,510
1894	20,000	1924	*
1895	12,000	Total value	$98,524

*See under Marble.

Travertine being deposited by mineral spring at Bridgeport, Mono County.

SANDSTONE.

Bibliography: State Mineralogist Reports XII–XV, XVII, XVIII, XXI. Bulletin 38. U. S. Bur. of M., Bull. 124.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as well as the popularity of a lighter-colored building stone, has curtailed production in this branch of the mineral industry during recent years almost to the vanishing point. In 1924 two counties—Monterey and Ventura—turned out 6700 cubic feet, valued at $3,600; compared with 7000 cubic feet and $13,000 in 1923. The main feature of the loss since 1914 is the closing of the well-known Colusa quarries, on account of the competition of lighter-colored materials. The material reported from Monterey County in 1924 is in reality an indurated shale of the Monterey series, of a cream-color and utilized as a building stone.

Sandstone Production of California, by Years.

Amount and value, so far as contained in the records of this Bureau, are presented herewith, with total value from 1887 to date:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887	----------	$175,000	1907	159,573	$148,143
1888	----------	150,000	1908	93,301	55,151
1889	----------	175,598	1909	79,240	37,032
1890	----------	100,000	1910	165,971	80,443
1891	----------	100,000	1911	255,313	127,314
1892	----------	50,000	1912	66,487	22,574
1893	----------	26,314	1913	62,227	27,870
1894	----------	113,592	1914	111,691	45,322
1895	----------	35,373	1915	63,350	8,438
1896	----------	28,379	1916	17,270	10,271
1897	----------	24,086	1917	31,090	7,074
1898	----------	46,384	1918	900	400
1899	56,264	103,384	1919	5,400	3,720
1900	378,468	254,140	1920	10,500	2,300
1901	266,741	192,132	1921	10,150	2,112
1902	212,123	142,506	1922	900	1,100
1903	353,002	585,309	1923	7,600	13,000
1904	363,487	567,181	1924	6,700	3,600
1905	302,813	483,268			
1906	182,076	164,068	Total value	----------	$4,112,583

SERPENTINE.

Bibliography: State Mineralogist Report XV. Bulletin 38.

Serpentine has not been produced in California to a very large extent at any time. A single deposit, that on Santa Catalina Island, has yielded the principal output to date. Some material was shipped from there in 1917 and 1918, being the only output recorded since 1907. It was used for decorative building purposes and for electrical switchboards. As there was but a single operator, the figures were combined with those of marble output for those years.

Serpentine Production of California, by Years.

The following table shows the amount and value of serpentine from 1895 as recorded by this Bureau:

Year	Cubic feet	Value	Year	Cubic feet	Value
1895	4,000	$4,000	1904	200	$2,310
1896	1,500	6,000	1905	----------	----------
1897	2,500	2,500	1906	847	1,694
1898	750	3,000	1907	1,000	3,000
1899	500	2,000	1917	a	a
1900	350	2,000	1918	b	b
1901	89	890	1919	----------	----------
1902	512	5,065			
1903	99	800	Totals	12,347	$33,259

[a] Under 'Unapportioned.'
[b] See under Marble.

SLATE.

Bibliography: State Mineralogist Reports XV, XVIII. Bulletin 38. U. S. Geol. Surv., Bull. 586. U. S. Bur. of Mines, Bull. 218.

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, but since then it has been irregular. Large deposits of excellent quality are known in the state, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

'Slate' is a term applied to a fine-grained rock that has a more or less perfect cleavage, permitting it to be readily split into thin, smooth sheets. Varieties differ widely in color and have a considerable range in chemical and mineralogical composition. Excepting certain rare slates of igneous origin (of which the green slate of the Eureka quarry, El Dorado County, California, is an example) formed from volcanic ash or igneous dikes, slates have originated from sedimentary deposits consisting largely of clay. By consolidation, and the pressure of superimposed materials, clays become bedded deposits of shale. By further consolidation under intense pressure and high temperature incident to mountain-building forces, shales are metamorphosed to slates. The principal mineral constitutents are mica, quartz, and chlorite, with smaller varying amounts of hematite, rutile, kaolin, graphite, feldspar, tourmaline, calcite, and others.

The color of slate is of economic importance. The common colors are gray, bluish gray, and black, though reds and various shades of green are occasionally found.

The permanency of slate for roofing is well known. It is stated that there are slate roofs in Pennsylvania and Maryland over 100 years old.[1]

[1]"In England and Wales, and in France, many buildings constructed in the 15th and 16th centuries were roofed with slate, and the roofs are still in excellent condition. There is a record of a chapel in Bedford-on-Avon in Wiltshire, England, roofed with slate in the 8th century, and after 1200 years of climatic exposure is moss-covered but in good condition."

Contrary to the general impression, however, the major portion of the slate produced in the United States is used on the inside rather than the outside of buildings. Its interior uses include stationary washtubs, electrical switchboards, and blackboards.

A square of roofing slate is a sufficient number of pieces of any size to cover 100 square feet of roof, with allowance generally for a three-inch lap. The sizes of the pieces of slate making up a square range from 7 x 9 inches to 16 x 24 inches, and the number of pieces in a square ranges from 85 to 686. The Ferry Building, San Francisco, is roofed with Eureka slate from El Dorado County.

In California, there were no shipments in 1924, but at present, there are prospects of commercial output being renewed.

[1] Bowles, O., Slate as a permanent roofing material: U. S. Bur. of M., Reports of Investigations, Serial No. 2267, July, 1921, p. 4.

Total Production of Slate in California.

A complete record of amount and value of slate produced in California follows:

Year	Squares	Value	Year	Squares	Value
1889	4,500	$18,089	1904	6,000	$50,000
1890	4,000	24,000	1905	4,000	40,000
1891	4,000	24,000	1906	10,000	100,000
1892	3,500	21,000	1907	7,000	60,000
1893	3,000	21,000	1908	6,000	60,000
1894	1,800	11,700	1909	6,961	45,660
1895	1,350	9,450	1910	1,000	8,000
1896	500	2,500	1911		
1897	400	2,800	1915	1,000	5,000
1898	400	2,800	1916		
1899	810	5,900	1920	8	80
1900	3,500	26,250	1921		
1901	5,100	38,250	1922	*	*
1902	4,000	30,000	1923		
1903	10,000	70,000			
			Totals	88,829	$676,479

*Concealed under 'Unapportioned.'

MISCELLANEOUS STONE.

Bibliography: State Mineralogist Reports XII–XXI (inc.). Bulletin 38; also annual statistical bulletins from 1915 to date.

'Miscellaneous stone' is the name used throughout this report as the title for that branch of the mineral industry covering crushed rock of all kinds, paving blocks, sand and gravel, and pebbles for grinding mills. The foregoing are very closely related from the standpoint of the producer; therefore it has been found to be most satisfactory to group these items as has been done in recent reports of this Bureau. So far as it has been possible to do so, crushed rock production has been subdivided into the various uses to which the product was put. It will be noted, however, a very large percentage of the output has been tabulated under the heading 'Unclassified.' This is necessary because of the fact that many of the producers have no way of telling to what specific use their rock was put after they have quarried and sold the same to distributors and contractors.

In addition to amounts produced by commercial firms, both corporations and individuals, there is hardly a county in the state but uses more or less gravel and broken rock on its roads. Of much of this, particularly in the country districts, there is no definite record kept.

For the year 1924, crushed rock registered gains both in tonnage and value over the preceding year; but sand and gravel showed a slight decrease. The result was a net gain for the group, the 1924 total value being $15,966,380 as compared with $15,395,652 in 1923. Continuance of general building work and highway paving are in part responsible as well as hydro-electric power-plant installations and harbor protection (breakwater and jetty construction).

As for some years past, Los Angeles County led all others by a wide margin with an output valued at $5,923,329 (compared with $5,408,808 in 1923); followed by Alameda, second, with $1,158,886; Del Norte, third, $721,720; Contra Costa, fourth, $646,369; Sacramento, fifth, $639,811; Shasta, sixth, $587,637; Riverside, seventh, $561,861; Orange, eighth, $505,932; followed in turn by Humboldt, Fresno, San Diego,

Marin, San Bernardino, San Benito, Napa, and Santa Clara, in the order named, each with a total between a half and a quarter-million dollars.

Paving Blocks.

The paving block industry has decreased materially of recent years, almost to the vanishing point, because of the increased construction of smoother pavements demanded by motor-vehicle traffic. The blocks made in Solano County were of basalt; those from Sonoma are of basalt, andesite, and some trachyte, while those from Placer, Riverside, San Bernardino, and San Diego are of granite.

Production in 1924 amounted to only 11 M, valued at $935.

The amount and value of paving block production annually since 1887 has been as follows:

Year	Amount M	Value	Year	Amount M	Value
1887	*10,000	$350,000	1907	4,604	$199,347
1888	10,500	367,500	1908	7,660	334,780
1889	7,303	297,236	1909	4,503	199,803
1890	7,000	245,000	1910	4,434	198,916
1891	5,000	150,000	1911	4,141	210,819
1892	*3,000	96,000	1912	11,018	578,355
1893	2,770	96,950	1913	6,364	363,505
1894	2,517	66,981	1914	6,053	270,598
1895	2,332	73,338	1915	3,285	171,092
1896	4,161	77,584	1916	1,322	54,362
1897	1,711	35,235	1917	938	38,567
1898	1,144	21,725	1918	372	17,000
1899	305	7,861	1919	27	1,350
1900	1,192	23,775	1920	63	3,155
1901	1,920	41,075	1921	4	280
1902	3,502	112,437	1922	72	3,924
1903	4,854	134,642	1923	15	880
1904	3,977	161,752	1924	11	935
1905	3,408	134,347			
1906	4,203	173,432	Totals	135,675	$5,314,538

* Figures for 1887-1892 (inc.) are for Sonoma County only, as none are available for other counties during that period; though Solano County quarries were then also quite active.

Grinding Mill Pebbles.

Production of pebbles for tube and grinding mills began commercially in California in 1915. Owing to the decreased imports and higher prices of Belgium and other European flint pebbles, due to the war, there was a serious inquiry for domestic sources of supply. One of the shipments made in that year was of pebbles selected from gold-dredger tailings in Sacramento County, for use in a gold mill in Amador County employing Hardinge mills.

The important development in this item, however, took place in San Diego County. At several points along the ocean shore from Encinitas south to near San Diego, there are beaches of washed pebbles varying from 1 inch to 6 inches in diameter, which come from conglomerate beds made up of well-rounded water-worn pebbles of various granitic and porphyritic rocks with some felsite and flint. The wave action has broken down portions of the cliffs for considerable distances and formed beaches of the pebbles which are well washed and cleaned of the softer materials. The rocks sorted out for shipment are mainly

basalt and diabase, with an occasional felsite and flint pebble. There is a tough black basalt which is stated to give satisfactory results. In Fresno County pebbles have been selected from the gravel beds of the San Joaquin River near Friant. Shipments have been made to metallurgical plants in California, Nevada, Montana and Utah.

Imports in 1924 amounted to 15,601 long tons, valued at $114,958 compared with 14,243 tons and $130,974 in 1923.

Californian output for 1924 was 434 tons, valued at $2,969, a decrease from the 1923 figures.

The amount and value of grinding mill pebbles, annually, follows:

Year	Tons	Value
1915	340	$2,810
1916	20,232	107,567
1917	21,450	90,538
1918	8,628	61,263
1919	2,607	19,272
1920	2,104	17,988
1921	247	1,418
1922	1,571	7,628
1923	2,650	14,936
1924	434	2,969
Totals	60,263	$256,394

Sand and Gravel.

A considerable part of the gravel excavated is passed through grading and washing plants, and the material over 2 inches in size is crushed. Much of it is utilized in concrete mixtures. Most of the gravel used for road surfacing and repairs as well as that for railroad ballast is creek-run or pit-run material which is spread upon the roads without undergoing any grading or washing.

The distribution of the 1924 output of sand and gravel, by counties, is given in the following table:

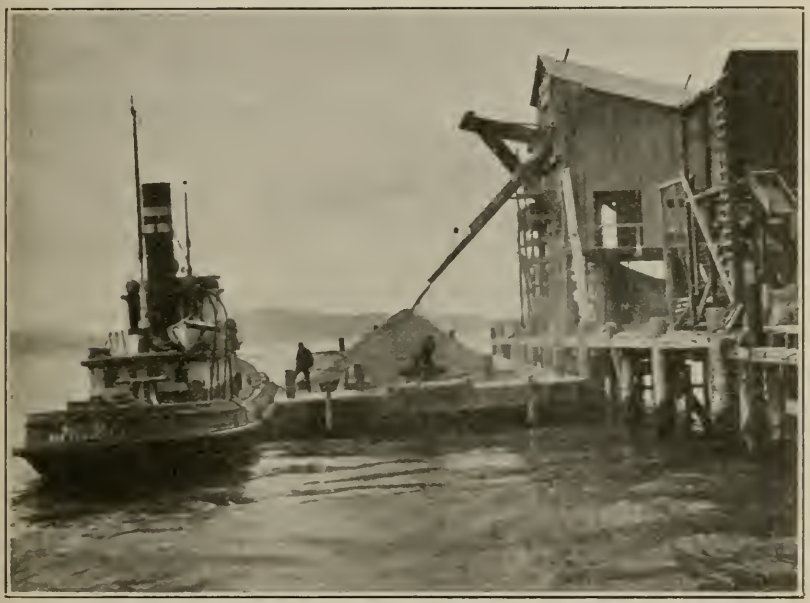
County	Tons	Value	County	Tons	Value
Alameda	[a]1,262,095	$809,818	San Benito	52,688	$26,111
Butte	80,000	45,500	San Bernardino	759,825	241,376
Calaveras	86,124	56,000	San Diego	[a]323,931	306,953
Colusa	100,222	75,167	San Francisco	10,000	5,000
Contra Costa	[a]87,763	48,004	San Joaquin	155,547	79,504
El Dorado	1,279	2,538	San Mateo	47,671	28,589
Fresno	376,779	262,722	Santa Barbara	66,004	45,777
Glenn	189,188	41,550	Santa Clara	217,592	155,053
Humboldt	233,626	190,109	Santa Cruz	15,033	13,294
Imperial	59,385	14,958	Shasta	177,265	197,078
Kern	15,345	4,044	Sierra	14,292	7,750
Lake	33,337	11,113	Siskiyou	21,600	16,000
Lassen	240	100	Sonoma	164,932	69,556
Los Angeles	3,479,620	1,720,251	Stanislaus	119,152	108,050
Mariposa	43,870	36,000	Tehama	16,435	15,694
Merced	15,090	8,462	Trinity	1,360	1,240
Mono	500	300	Tulare	5,000	8,000
Monterey	[b]245,896	239,097	Ventura	[a]177,454	113,763
Napa	187,376	151,876	Yuba	259,997	181,113
Nevada	30,262	22,200	Amador, Madera, Marin, Mendocino, Modoc, San Luis Obispo, Solano, Yolo*	105,376	63,953
Orange	516,900	405,932			
Placer	17,433	10,753			
Riverside	[a]14,300	14,500			
Sacramento	[a]350,021	217,159	Totals	10,137,805	$6,072,007

*Combined to conceal output of a single operator in each.
[a]Includes molding sand.
[b]Includes molding, blast, filter, and roofing sand.

Included in the above is a total of 32,968 tons of molding sand, valued at $68,105, f. o. b. pit, from two operators in San Diego County, and one each in Alameda, Contra Costa, Monterey, Riverside, Sacramento, and Ventura. This item is each year assuming a more important position in the commercial mineral list of California. The 1923 figures totaled 33,194 tons and $66,634.

Crushed Rock.

To list the kinds and varieties of rock utilized commercially under this heading would be to run almost the entire gamut of the classification scale. Much depends on the kind available in a given district.



Loading crushed rock on barge at quarry of Blake Bros., Point Richmond, Contra Costa County.

Those which give the most satisfactory service are the basalts and other hard, dense, igneous rocks which break with sharp, clean edges. In many localities, river-wash boulders form an important source of such material. In such cases, combined crushing and washing plants obtain varying amounts of sand and gravel along with the crushed sizes. In Sacramento and Butte counties the tailings piles from the gold dredgers are the basis of like operations.

The values given are based on the selling prices, f. o. b. cars, barges, or trucks, at the quarry.

Crushed Rock Production, by Counties, for 1924.

County	Macadam and Ballast		Rubble and Riprap		Concrete		Unclassified		Totals	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Alameda	31,337	$27,580	150	$720	219,701	$306,416	[a]24,634	$14,352	275,822	$349,068
Alpine	3,066	2,530							3,066	2,530
Butte	20,000	15,000					[c]95,500	77,500	115,500	92,500
Calaveras							[c]7,500	27,250	7,500	27,250
Contra Costa	32,705	31,378	2,974	3,347	50,034	56,289	622,474	507,351	708,187	598,365
Fresno							248,756	188,818	248,756	188,818
Humboldt	76,286	166,340	[d]40,000	120,000					116,286	286,340
Imperial	1,500	1,500	62,637	11,750	40,912	41,824	8,000	8,000	113,049	63,074
Lake	5,860	11,720							5,860	11,720
Lassen	42,330	35,514							42,330	35,514
Los Angeles	1,592,340	1,013,943	244,796	391,674	2,775,654	1,970,228	[f][g]1,124,310	827,233	5,737,100	4,203,078
Marin			*		*		[c]8,250	6,500	8,250	6,500
Mariposa							[c]2,270	12,000	2,270	12,000
Mendocino	28,266	46,680							28,266	46,680
Mono	14,790	18,744							14,790	18,744
Napa	46,554	41,549			43,059	44,098	21,333	24,000	110,946	109,647
Placer	5,000	3,000	710	820			450	1,000	6,160	4,820
Riverside	*		*		*		[h]1,350	12,650	1,350	12,650
Sacramento	80,621	51,201	6,143	3,378	50,452	52,542	428,486	315,531	565,702	422,652
San Benito	298,063	207,258			*				298,063	207,258
San Diego	1,000	500	3,744	4,712	41,673	45,460	41,333	18,500	87,750	69,172
San Francisco	1,200	600	47,473	60,529	1,400	1,000	57,794	83,129	107,867	145,258
San Mateo	30,345	30,214			13,466	15,150	666	1,125	44,477	46,489
Santa Clara	10,000	7,500			5,000	3,000	124,626	93,470	139,626	103,970
Santa Cruz	6,924	5,322	*		*				6,924	5,322
Shasta	96,417	146,090	2,442	2,748	161,529	241,721			260,388	390,559
Sierra					500	250			500	250
Siskiyou	62,731	51,787							62,731	51,787
Sonoma	25,395	26,042	61	46	3,637	5,365			29,093	31,453
Tehama	10,327	10,260			133	100			10,460	10,360
Trinity							500	1,000	500	1,000
Tulare	39,356	29,729	6,729	1,062	15,000	20,000	[b]20,235	21,620	81,360	72,411
Tuolumne	2,100	1,500					[j][k]2,080	11,000	4,180	12,500
Ventura	26,000	34,000			12,000	18,000	9,072	7,574	47,072	59,574
Amador, Del Norte, Inyo, Merced, Nevada, Riverside, San Luis Obispo, Santa Barbara, Solano*	373,806	443,978							373,806	443,978
Del Norte[d], Madera, Marin, Riverside, San Bernardino, Santa Cruz*			496,171	736,274					496,171	736,274

Marin, Nevada, Orange, Riverside, San Benito, San Bernardino, San Joaquin, Santa Cruz, Stanislaus*					985,455	856,332			985,455	856,332
Amador[b], Inyo*[f], Kern[g], San Bernardino, Santa Barbara, Solano*							165,711	154,572	165,711	154,572
Totals	2,964,319	$2,461,459	914,070	$1,337,060	4,419,605	$3,677,775	3,015,330	$2,414,175	11,313,324	$9,890,469

*Combined to conceal output of a single operator in each.
[a]Includes red shale, roofing granules.
[b]Includes red sandstone roofing granules.
[c]Includes green stone for roofing and stucco dash.
[d]Includes large stone up to 10-ton blocks for breakwater (jetty) construction.
[e]Includes yellow dolomitic marble for stucco granules.
[f]Includes red roofing granules.
[g]Includes red and green roofing granules.
[h]Includes granite granules for roofing and stucco dash.
[i]Includes quartz granules for roofing.
[k]Includes marble granules for terrazzo.

Miscellaneous Stone Production of California, by Years.

The amount and value, annually, of crushed rock (including macadam, ballast, rubble, riprap, and that for concrete), and sand and gravel, since 1893, follow:

Crushed Rock, Sand and Gravel, by Years.

Year	Tons	Value	Year	Tons	Value
1893	371,100	$456,075	1910	5,827,828	$2,777,690
1894	661,900	664,838	1911	6,487,223	3,610,357
1895	1,254,688	1,095,939	1912	8,044,937	4,532,598
1896	960,619	839,884	1913	9,817,616	4,823,056
1897	821,123	600,112	1914	9,288,397	3,960,973
1898	1,177,365	814,477	1915	10,879,497	4,609,278
1899	964,898	786,892	1916	9,951,089	4,009,590
1900	789,287	561,642	1917	8,069,271	3,505,662
1901	530,396	641,037	1918	6,641,144	3,325,889
1902	2,056,015	1,249,529	1919	6,919,188	3,678,322
1903	2,215,625	1,673,591	1920	9,792,122	6,782,414
1904	2,296,898	1,641,877	1921	10,914,145	7,834,640
1905	2,624,257	1,716,770	1922	13,049,644	10,366,231
1906	1,555,372	1,418,406	1923	19,840,301	15,379,838
1907	2,288,888	1,915,015	1924	21,451,129	15,962,476
1908	3,998,945	3,241,774	Totals	187,072,468	$117,185,198
1909	5,531,561	2,708,326			

A comparison of the above table of annual production of these materials with the similar table for cement (see *ante*), reveals the fact that the important growth of the crushed rock and gravel business has been coincident with the rapid development of the cement industry from the year 1902.

CHAPTER FIVE.

INDUSTRIAL MATERIALS.

Bibliography: Reports XII–XX (inc.). Bulletin 38. Min. & Sci. Press, Vol. 114, March 10, 1917. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

The following mineral substances have been arbitrarily arranged under the general heading of 'Industrial Materials,' as distinguished from those which have a clearly-defined classification, such as metals, salines, structural materials, etc.

These materials, many of which are mineral earths, are, with four or five exceptions, as yet produced on a comparatively small scale. The possibilities of development along several of these lines are large and with increasing transportation and other facilities, together with steadily growing demands, the future for this branch of the mineral industry in California is promising. There is scarcely a county in the state but might contribute to the output.

Up to within the last few years, at least, production has been in the majority of instances dependent upon more or less of a strictly local market, and the annual tables show the results of such a condition, not only in the widely-varying amounts of a certain material produced from year to year, but in widely-varying prices of the same material. Furthermore, the quality of this general class of material will be found to fluctuate, even in the same deposit.

The more important of these minerals thus far exploited, so far as shown by value of the output, are limestone, mineral water, pyrites, pottery clays, diatomaceous earth, gypsum, talc, dolomite. One new item, galena crystals utilized for radio-detector apparatus, was added to the list in 1924.

This group as a whole showed a slight decrease in the total value, from $5,595,816 in 1923 to $5,112,812 for 1924. The principal gains were by limestone and mineral water; with losses by clay, gypsum, diatomaceous earth, pyrite, and talc.

The following table gives the comparative figures for the amounts and values of industrial minerals produced in California during the years 1923 and 1924:

Substance	1923		1924		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Asbestos	20 tons	$200	70 tons	$4,750	$4 550+
Barytes	2,925 tons	16,058			16,058—
Clay (pottery)	376,863 tons	697,841	417,928 tons	651,857	45,984—
Dolomite	69,519 tons	142,615	28,843 tons	71,271	71,344—
Feldspar	11,100 tons	81,800	9,055 tons	68,112	13,688—
Fuller's earth	3,650 tons	55,125	5,290 tons	67,295	12,170+
Gems		13,220		4,800	8,420—
Gypsum	86,410 tons	289,136	25,569 tons	53,210	235,926—
Infusorial and diatomaceous earths	*	*	*	*	—
Limestone	143,266 tons	348,464	219,476 tons	582,660	234,196+
Lithia			109 tons	2,269	2,269+
Mineral paint	1,049 tons	11,773	532 tons	5,234	6,539—
Mineral water	5,487,276 gals.	616,919	8,159,211 gals.	818,726	201,807+
Pumice and volcanic ash	2,936 tons	16,309	4,919 tons	33,404	17,095+
Pyrites	148,004 tons	555,308	124,214 tons	517,835	37,473—
Shale oil	*	*	*	*	+
Silica (sand and quartz)	7,964 tons	30,420	6,808 tons	35,006	4,586+
Sillimanite and andalusite	*	*	*	*	—
Soapstone and talc	17,439 tons	252,661	16,179 tons	242,770	9,891—
Sulphur	*	*	*	*	—
Unapportioned*		2,467,967		1,953,613	514,354—
Total values		$5,595,816		$5,112,812	
Net decrease					$483,004—

*Combined under 'Unapportioned.'

* In 1923 includes diatomaceous earth, shale oil, andalusite-sillimanite, sulphur; in 1924 includes diatomaceous earth, shale oil, andalusite-sillimanite, sulphur, mica schist, radio galena crystals.

ASBESTOS.

Bibliography: State Mineralogist Reports XII–XIX (inc.). Bulletins 38, 91. Canadian Dept. of M., Mines Branch Bulletin 69. Min. & Sci. Press, April 10, 1920, pp. 531–533. Eng. & Min. Jour.–Press, Vol. 113, pp. 617–625; 670–677.

In 1924, a total of 70 tons of crude asbestos ore and fibre valued at $4,750 was shipped from Californian properties, being an increase over the 20 tons and $200 reported in 1923. This was mainly due to the shipments of short-fibre chrysotile from San Benito County to the Orient. The 1924 figure also includes amphibole asbestos utilized in magnesite composition flooring.

The future of asbestos mining in California is dependent largely upon the development of uses in quantity for the short-fibre mill grades, and for the amphibole variety. There are apparently large resources of such material that can be made available. Some spinning-grade fibre has also been found in this state, notably in Nevada, Calaveras, and Monterey counties, but the commercial yield to date has been small. There are extensive serpentine areas in the Coast Ranges, in the Klamath Mountains, and in several sections of the Sierra Nevada Mountains which are within the range of possible asbestos producers, as chrysotile is a fibrous form of serpentine. These localities all yielded chromite in greater or less amounts during the World War period.

Asbestos Production of California, by Years.

Total amount and value of asbestos production in California since 1887, as given in the records of this Bureau, are as follows:

Year	Tons	Value	Year	Tons	Value
1887	30	$1,800	1907	70	$3,500
1888	30	1,800	1908	70	6,100
1889	30	1,800	1909	65	6,500
1890	71	4,260	1910	200	20,000
1891	66	3,960	1911	125	500
1892	30	1,830	1912	90	2,700
1893	50	2,500	1913	47	1,175
1894	50	2,250	1914	51	1,530
1895	25	1,000	1915	143	2,860
1896	----------	----------	1916	145	2,380
1897	----------	----------	1917	136	10,225
1898	10	200	1918	229	9,903
1899	30	750	1919 } *	131	6,240
1900	50	1,250	1920 }		
1901	110	4,400	1921	410	19,275
1902	----------	----------	1922	50	1,800
1903	----------	----------	1923	20	200
1904	10	162	1924	70	4,750
1905	112	2,625			
1906	70	3,500	Totals	2,826	$133,725

*Annual details concealed under 'Unapportioned.'

BARYTES.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII. Bulletin 38. Eng. & Min. Jour.-Press, Vol. 114, p. 109, July 15, 1922; Vol. 115, pp. 319–324, Feb. 17, 1923.

There were no commercial shipments of crude barytes in California during 1924. In 1923, the output amounted to a total of 2925 tons valued at $16,058 f.o.b. rail-shipping point. The 1923 product came mainly from Nevada County, with smaller amounts from Mariposa and Shasta counties, and was consumed principally in the manufacture of lithopone. More than half of the total tonnage of barytes utilized in the United States is taken in the manufacture of lithopone, which is a chemically-prepared, white pigment containing approximately 70% barium sulphate and 30% zinc sulphide. This is one of the principal constituents of 'flat' wall paints.

The principal uses for barytes, after washing and grinding, are as an inert pigment and filler in paint, paper, linoleum, oilcloth and rubber manufacture, and in the preparation of lithopone and a number of chemicals. The most important of such chemicals, other than lithopone, are: barium binoxide (used in preparation of hydrogen peroxide); barium carbonate (used by pressed brick and by rubber manufacturers to neutralize sulphur content); barium chloride (used in battery plates, and as a mordant by dry-color manufacturers, and in tanning leather); barium nitrate (used in munitions and in making 'red fire' material); barium sulphate precipitated, or 'blanc fixe'

(used in rubber manufacture; for painting on interior steel of battleships and other sea-going vessels; also as a detector in taking X-ray pictures of the human body).

Present quotations for barytes vary from $7 to $9 per ton, crude, f. o. b. rail shipping point, depending on quality. Most baryte has to be washed and acid treated to remove iron stains or other impurities before being suitable for paint use.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta and Santa Barbara counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). Witherite has also been found in Shasta County, but no shipments have yet been made from the deposit.

Total Barytes Production of California.

The first recorded production of barytes in California, according to the statistical reports of the State Mining Bureau, was in 1910. The annual figures are as follows:

Year	Tons	Value	Year	Tons	Value
1910	860	$5,640	1918	100	$1,500
1911	309	2,207	1919	1,501	18,065
1912	564	2,812	1920	3,029	20,795
1913	1,600	3,680	1921	901	4,809
1914	2,000	3,000	1922	3,370	18,925
1915	410	620	1923	2,925	16,058
1916	1,606	5,516	1924		
1917	4,420	25,633	Totals	23,595	$129,260

CLAY (Pottery).

Bibliography: State Mineralogist Reports I, IV, IX, XII–XV, XVIII–XXI (inc.). Bulletin 38. Preliminary Report No. 7. U. S. Bureau of Standards, Tech. Paper No. 262.

At one time or another in the history of the state, pottery clay has been quarried in thirty-three of its counties. In this report, 'pottery clay' refers to all clays used in the manufacture of red and brown earthenware, china and sanitary ware, flowerpots, floor, faience and ornamental tiling, architectural terra cotta, sewer pipe, drain and roof tile, etc., and the figures for amount and value are relative to the crude material at the pit, without reference to whether the clay was sold in the crude form or was immediately used in the manufacture of any of the above finished products by the producer. It does not include clay used in making brick and hollow building blocks.

That California has attained to an important position in her clay products industry is attested to in a recent article[1] from the manager of one of the large plants in the southern part of the state; and from which we quote the following:

"The importance of California's brick and clay products industry will be appreciated when it is understood that no other State in the Union comes as near to producing all of its requirements in these lines as does California. There is manufactured within the State all the sewer pipe used, all of the common brick, face brick, pressed brick,

[1]Linton, Robt., California's brick and clay products industry: Cal. Jour. of Development, June 1925, pp. 5–6, 25–26.

enamelled brick, terra cotta, roofing tile, hollow building tile, drain tile, vitrified clay conduit, flue lining, chimney pipe, quarry tile and faience tile, decorative tile, ollas, flower pots and other red earthenware and brown stoneware.

"There is further manufactured the major portion of fire brick and refractory shapes for steel mills, railroads, oil refineries, sugar mills, enamelled sanitary ware, etc., and a considerable portion of the white ware, chemical ware and clay specialties consumed within the State. Not only do California manufacturers entirely supply the State in these articles, but considerable quantities are supplied to contiguous territory and certain products are shipped over a much wider radius. Enamelled brick and tile from California plants are shipped as far north as Oregon and exported to Hawaii. Hawaii also purchases considerable quantities of California-made sewer pipe, stone-ware, and other clay products. Super-refractories and decorative tile from California plants are shipped all over the country, even as far as the eastern seaboard.

"Clay products, which are not made in this State, and, therefore, continue to be shipped in from other points, are limited to certain lines of refractories, chemical ware, high voltage insulators, fine china, spark plugs, novelties and other specialties. From time to time foreign countries attempt to take advantage of the cheap ocean transportation afforded by tramp steamers to dump their surplus products on California shores. English and Scotch fire brick, Welsh and Scandinavian quarry tile, Dutch roof tile are among such products. These importations do not, however, at the present time replace California made products to any extent.

* * * * * * * * * * *

"Apparently the clays in Placer, Amador and Riverside counties will continue to provide the major sources of supply for our clay plants for some time to come, but when they do eventually approach exhaustion, undoubtedly prospecting will disclose ample new supplies to take their place.

"California clay beds as compared with those in the Mississippi and Ohio valleys, which furnish the raw materials for most of the clay plants in the East, are small in size and irregular in character and grade. As a matter of fact it is only by careful control of mining and by proper blending of the clays that the recognized high quality of California clay products has been attained. With the exception of common brick and roof tile, usually at least three clays enter into the manufacture of almost any California clay ware.

"Actually we would not expect to find on the Pacific slope clay deposits comparable in size and uniformity with the great clay beds of the Mississippi basin. California clays were laid down in arms of bays which in Tertiary geologic time extended in from the Pacific Ocean. The coastal plain was narrow even then. Disintegration of the feldspathic igneous rocks from which the clays are derived did not take place until recent periods. None of the clays are earlier then Eocene. Consequently, although the igneous rocks contained abundant clay-making materials they were no large settling areas available for collecting them as the igneous rocks disintegrated, and they were deposited only in the arms of certain bays where conditions of currents were favorable. Nor was there opportunity for extensive purification by repeated washing down and re-deposition.

* * * * * * * * * * *

"The principal cost factors entering in the production of clay products are: Clay, fuel, labor, transportation. At present the industry in California is in a favorable position as regards fuel, there being ample supplies of oil and gas, and as regards a satisfactory labor supply; although wage rates are higher than the average paid in Eastern plants. The suggestions submitted concern the other two. As already stated, great care is necessary in working out the proper blending of California clays to produce wares of required quality, and in maintaining proper control of the blending when once decided upon. The clays required for blending often have to be brought from points quite widely separated, and to the unavoidably high cost of operating small clay mines there must be added the cost of transportation to the plants. This item of freight is a really large one. At a local sewer pipe plant the freight on the clays used varies from $1.00 to $1.80 per ton. At a local brick plant the freight on the clays used varies from $1.00 to $4.30 per ton. Compare this with costs of clays used at Eastern plants making similar wares where the clay delivered at the plants frequently varies somewhere between 25¢ and 50¢ per ton, and it will readily be appreciated why California costs are high as compared with Eastern costs, and why we are all constantly seeking new supplies of clay which can be delivered to our plants at lower cost."

There are many other important uses for clays besides pottery manufacture. Among these may be enumerated paper, cotton goods, and chemicals. Being neutral, clay does not have an injurious effect upon other constituents used in the manufacture of such articles. In paper making, clay is used as a filler in news and similar grades, and as a coater or glazer in the more highly finished art papers. A large part of the china clay used in the United States is imported from England. Clays of the montmorillonite and halloysite group ('rock soap') are being utilized successfully in the manufacture of soaps.

During 1924, a total of 48 producers in 19 counties reported an output of 417,928 short tons of pottery clay, having a total value of $651,858 f. o. b. rail-shipping point, for the crude material, as compared with the 1923 production of 376,863 tons worth $697,841.

Because of the fact that a given product often requires a mixture of several different clays, and that these are not all found in the same pit, it is necessary for most clay-working plants to buy some part of their raw materials from other localities. For these reasons, in compiling the clay industry figures, much care is required to avoid duplications. So far as we have been able to segregate the figures, from the data sent in by the operatives, we have credited the clay output to the counties from which the raw material originated; and have deducted tonnages used in brick manufacture, as bricks are classified separately, herein.

A tabulation of the direct returns from the producers, by counties, for the year 1924, is shown herewith:

Pottery Clay, in 1924.

County	Tons	Value	Used in the manufacture of—
Alameda	2,482	$1,124	Floor and drain tile, flue lining, sewer and chimney pipe.
Amador	64,317	87,444	Roofing and drain tile, sewer and chimney pipe, flue lining, architectural terra cotta, refractories, and stoneware, and various.
Los Angeles	81,065	132,855	Roofing, floor, faience and drain tile, sewer and conduit pipe, flue lining, architectural terra cotta, ground fire clay, chinaware, and various.
Monterey	238	436	Roofing and floor tile.
Placer	97,670	146,508	Drain and roofing tile, architectural terra cotta, sewer pipe, and various.
Riverside	121,193	166,692	Floor and faience tile, pottery and porcelain, and various.
Sacramento	1,750	4,470	Drain tile and sewer pipe, red earthenware, refractories.
San Diego	[b]12,783	36,941	Floor and faience tile, stoneware, and various.
Santa Clara	5,341	5,666	Roofing, floor and faience tile, foundry casting, red earthenware, and various.
Calaveras, Contra Costa, Humboldt, Kern, Marin, Merced, Orange, San Bernardino[a], Santa Barbara, Tuolumne*.	28,089	69,721	Roofing and drain tile, sewer and chimney pipe, architectural terra cotta, crushed brick for roofing, toilet preparations, porcelain, sanitary ware, and various.
Totals	417,928	$651,857	

*Combined to conceal output of a single operator in each.
[a]Includes kaolin.
[b]Includes 'Cornwall stone.'

Pottery Clay Products.

The values of the various pottery clay products made in California during 1924 totaled $12,015,361, compared with $10,523,168 in 1923, their distribution being shown in the following tabulation:

Product	Number of producers	Tons	Value
Architectural terra cotta	6	17,605	$2,783,608
Chimney pipe, terra cotta, and flue linings	7	7,475	264,245
Drain tile	10	8,291	113,875
Roofing tile	10	45,886	1,269,064
Sewer pipe	8	68,725	2,054,518
Stoneware and chemical stoneware	5	------	363,679
Sanitary ware	4	------	2,319,606
Chinaware and semi-vitreous tableware	3	------	596,214
Red earthenware	4	------	183,029
Floor, faience, mantel, glazed and hand-made tile	15	------	1,383,951
Miscellaneous art pottery, terra cotta, garden furniture, mortar colors, vitrified conduit, bisque ware and doll heads, grog, fire clay, refractories, porcelain, electrical insulators, crushed tile for roofing	15	------	683,572
Total value	------	------	$12,015,361

Important increases were shown by several of the above groups, particularly architectural terra cotta, roofing tile, sanitary ware, and flat tile (floor, faience, mantel, etc.).

Pottery Clay Production of California, by Years.

Amount and value of crude pottery clay output in California since 1887 are given in the following table:

Year	Tons	Value	Year	Tons	Value
1887	75,000	$37,500	1907	160,385	$254,454
1888	75,000	37,500	1908	208,042	325,147
1889	75,000	37,500	1909	299,424	465,647
1890	100,000	50,000	1910	249,028	324,099
1891	100,000	50,000	1911	224,576	252,759
1892	100,000	50,000	1912	199,605	215,683
1893	24,856	67,284	1913	231,179	261,273
1894	28,475	35,073	1914	179,948	167,552
1895	37,660	39,685	1915	157,866	133,724
1896	41,907	62,900	1916	134,636	146,538
1897	24,592	30,290	1917	166,298	154,602
1898	28,947	33,747	1918	112,423	166,788
1899	40,600	42,700	1919	135,708	245,019
1900	59,636	60,956	1920	203,997	440,689
1901	55,679	39,144	1921	225,120	362,172
1902	67,933	74,163	1922	277,232	473,184
1903	90,972	99,907	1923	376,863	697,841
1904	84,149	81,952	1924	417,928	651,857
1905	133,805	130,146			
1906	167,267	162,283	Totals	5,371,736	$6,961,758

DOLOMITE.

Bibliography: Reports XV, XVII–XXI (inc.). Bulletins 67, 91.

The production of dolomite for the year 1924 totaled 28,843 tons valued at $81,271, being a decrease from the 69,519 tons and $142,615 of 1923, and came from a total of eight quarries in Inyo, Monterey, San Benito, and Tuolumne counties. The decrease was due mainly to a falling off of shipments from Inyo and Monterey counties. The material shipped was utilized for steel-furnace lining, manufacture of CO_2, flux, burned dolomitic lime, for stucco dash-coat, and terrazzo.

The 1924 output was distributed as follows:

County	Tons	Value
Inyo	17,197	$37,491
Monterey	1,240	4,960
San Benito and Tuolumne*	10,406	28,820
Totals	28,843	$71,271

*Combined to conceal output of a single quarry in each.

Dolomite Production of California, by Years.

Previous to the 1915 statistical report of the State Mining Bureau, dolomite was included under limestone, as the two minerals are closely related, chemically; but since dolomite, as such, has been found to have certain distinctive applications, we have given it a separate classification.

Amount and value of the output of dolomite, annually, have been as follows:

Year	Tons	Value
1915	4,192	$14,504
1916	13,313	46,566
1917	27,911	66,416
1918	24,560	79,441
1919	24,502	67,953
1920	42,388	132,791
1921	31,195	99,155
1922	52,409	114,911
1923	69,519	142,615
1924	28,843	71,271
Totals	318,832	$835,623

FELDSPAR.

Bibliography: Reports XV, XVII, XVIII, XXI. Bulletins 67, 91. U. S. Bureau of Mines, Bulletin 92. Eng. & Min. Jour.-Press, Vol. 115, pp. 535–538, Mar. 24, 1923.

Feldspar was produced by nine operators in two counties (Riverside and San Diego) during 1924, to the amount of 9,055 tons, valued at $68,112, being a slight decrease both in quantity and value from the 1923 figures which were 11,100 tons and $81,800.

The product was used in the ceramic industry, principally in pottery, porcelain, enamel wares, also enamel brick and tile, being a constituent of both the body and the glaze, but more especially the latter.

The requirements of the pottery trade demand that in general the percentage of free silica associated with the feldspar be less than 20%, and in some cases the potters specify less than 5%. An important factor, also, is the iron-bearing minerals frequently present in pegmatites and granites, such as biotite (black mica), garnet, hornblende, and black tourmaline. Feldspar for pottery uses should be practically free of these. The white, potash-mica, muscovite, is not particularly objectionable except that, being in thin, flexible plates, it does not readily grind to a fineness required for the feldspar.

Present quotations are from $5 to $8 per ton, crude, according to quality.

The most important recent developments in the feldspar resources of California have taken place in San Diego and Riverside counties, where large deposits of massive, high-grade spar are being opened up. These deposits are unusually free from black mica and other deleterious iron-bearing minerals objectionable in pottery work. The important producing districts are near Lakeside and Campo, in San Diego County, and near Lakeview, Murrietta, and Elsinore, in Riverside County. No shipments have been reported from Monterey and Tulare counties for the past four years.

Total Feldspar Production of California.

Total amount and value of feldspar production in California since the inception of the industry are given in the following table, by years:

Year	Tons	Value	Year	Tons	Value
1910	760	$5,720	1918	4,132	$22,061
1911	740	4,560	1919	1,272	12,965
1912	1,382	6,180	1920	4,518	26,189
1913	2,129	7,850	1921	4,349	28,343
1914	3,530	16,565	1922	4,587	37,109
1915	1,800	9,000	1923	11,100	81,800
1916	2,630	14,350	1924	9,055	68,112
1917	11,792	46,411			
			Totals	63,776	$387,210

FLUORSPAR.

Bibliography: Reports XVII, XVIII. Bulletins 67, 91. Eng. & Min. Jour.-Press, Vol. 117, pp. 489–492, Mar. 22, 1924.

Fluorspar, which is calcium fluoride, CaF_2, is one of the most important non-metallic minerals from an industrial standpoint. About 80% of the commercial mineral is prepared in the 'gravel' form and utilized as a flux in the manufacture of steel, for which use no substitute has yet been found. In the United States, under normal business conditions, the consumption for that purpose is 125,000 to 150,000 tons annually. Fluorspar is also used in aluminum smelting, and in the manufacturing of enameled ware, glazed tile and brick, opalescent glass, and certain chemicals, particularly hydrofluoric acid and its derivatives. The mineral is marketed in three forms: lump, gravel, and ground.

[1]"Of the three physical forms of fluorspar of commerce, lump, gravel, and ground, two grades of each form are marketed. Lump and gravel are sold as metallurgical or fluxing grades, and acid grades; ground is sold as glass-enamel-ceramic grade, and acid grade. Lump spar of either grade should not be too large, and small lump, not exceeding 6 in. in diameter, is preferred by the trade. Specifications for physical form of metallurgical lump spar demand a minimum content of gravel fluorspar, as fines, in any carload, say not exceeding one ton. Metallurgical gravel spar should not be too fine, and coarse gravel with minimum content of fluorspar sand, as fines, is more acceptable to the trade. Size specifications for metallurgical gravel spar demand that it shall pass through a 1-in. ring.

"The market specifications for standard fluorspar in any form are mainly chemical and governed by analysis. Guaranteed analysis for standard metallurgical or fluxing grade spar, lump or gravel, is minimum of 85 per cent calcium fluoride, and maximum of 5 per cent silica. Merchantable grade acid-spar, lump, gravel and ground, varies somewhat with different users. Not exceeding 2 per cent silica and under 97 per cent calcium fluoride are the limits. Part of the trade insists on a guaranteed minimum of 98 per cent calcium fluoride and maximum of 1 per cent silica, though some consumers are satisfied with a guaranteed minimum of 97 per cent calcium fluoride and maximum of 2 per cent silica. Glass-enamel-ceramic grade ground fluorspar specifications are flexible, the users of that class of spar particularly demanding fine grinding, preferably 150 to 200 mesh, and thorough washing free from alumina; also freedom from contamination of metallic ores and barytes. Analyses for glass-enamel-ceramic spar vary from 90 to 95 per cent calcium fluoride, 2 to 5 per cent silica, and 2 to 8 per cent calcium carbonate.

"The usual impurities in fluorspar are silica and calcium carbonate, which are penalized, as a rule. Minor impurities in fluorspar are ores of lead and zinc, generally the sulphides, and pyrites and barytes, all of which are objectionable, and sometimes penalized.

[1] Reed, A. H., Marketing of fluorspar: Eng. & Min. Jour.-Press, Vol. 117, p. 489, Mar. 22, 1924.

"No premiums are allowed on fluorspar shipments, but there is a penalty for inferior material. Trade specifications demand that for each point of calcium fluoride less than 85 per cent there shall be deducted 1/85th of the delivered cost, and for each point of silica over 5 per cent there shall be deducted 1/40th of the delivered cost."

According to the U. S. Bureau of Foreign and Domestic Commerce, imports of fluorspar into the United States in 1924 amounted to 45,574 long tons, valued at $555,642, and came principally from England, with smaller amounts from British South Africa, Italy, China, and Netherlands. Domestic shipments of fluorspar, according to the U. S. Geological Survey, totaled 124,979 short tons, valued at $2,451,131.

In California deposits have been reported in Los Angeles, Mono, Riverside and San Bernardino counties, but no commercial production has resulted except in 1917–1918, when a total of 79 tons valued at $991 was shipped from Riverside County.

In 1921, at the King Mine under development near Afton, San Bernardino County, some fluorspar was mined but not shipped. Field examinations have indicated a considerable deposit there of merchantable spar.

The Tariff Act of 1922 places a duty of $5.60 per ton on foreign importations of fluorspar.

Present quotations (Engineering and Mining Journal-Press, New York) are: f.o.b. Middle Western Mines, per net ton. Gravel, not less than 85% CaF_2 and not over 5% SiO_2, $15–$18; foundry lump $19–$21.

FULLER'S EARTH.

Bibliography: Reports XIV, XVII, XVIII, XXI. Bulletins 38, 91. U. S. Bureau of Mines, Bulletin 71.

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color, and some varieties disintegrate in water. In California, fuller's earth has been used in clarifying both refined mineral and vegetable oils, and for special chemical purposes; although its original use was in fulling wool, as the name indicates. Production has come mainly from Calaveras and Solano counties, with other deposits noted also in Riverside, Fresno, Inyo, and Kern counties.

Clays of the montmorillonite and halloysite group ('rock soap') are being utilized by some of the oil refineries in lieu of true fuller's earth in the refining of petroleum products.

The production of 5,290 tons valued at $67,295, here credited to 1924 as 'fuller's earth' is in reality collodial clay of the montmorillonite class (sold under such local names as 'bentonite,' 'otaylite,' 'shoshonite,' derived from the locality where found). Because of its being utilized for clarifying, filtering, and cleanser purposes, most of it in petroleum refining, we have placed it for the purposes of this statistical report, under the 'fuller's earth' heading. After all, the practical test of a fuller's earth is not so much chemical, as a practical physical one; that is its physical capacity to absorb basic colors and to remove these colors from solution in animal, vegetable, or mineral oils, also from water.

The 1924 output above noted is an increase both in tonnage and value

over the 3650 tons and $55,125 credited to the year 1923, and came from four properties, in Inyo, San Bernardino, and San Diego counties.

Fuller's Earth Production of California, by Years.

Fuller's earth was first produced commercially in this state in 1899, and the total amount and value of the output since that time are as follows:

Year	Tons	Value	Year	Tons	Value
1899	620	$12,400	1913	460	$3,700
1900	500	3,750	1914	760	5,928
1901	1,000	19,500	1915	692	4,002
1902	987	19,246	1916	110	550
1903	250	4,750	1917	220	2,180
1904	500	9,500	1918	37	333
1905	1,344	38,000	1919	385	3,810
1906	440	10,500	1920	600	6,000
1907	100	1,000	1921	1,185	8,295
1908	50	1,000	1922	6,606	48,756
1909	459	7,385	1923	3,650	55,125
1910	340	3,820	1924	5,290	67,295
1911	466	5,294			
1912	876	6,500	Totals	27,927	$348,619

NOTE.—Above production since 1921 has been montmorillonite (hydrous aluminum silicate) a colloidal clay, sometimes called 'rock soap,' and in part locally called 'shoshonite' from its being found near Shoshone in Inyo County; and in part 'otaylite' from Otay, San Diego County.

GEMS.

Bibliography: State Mineralogist Reports II, XIV, XV, XVII, XVIII, XX, XXI. Bulletins 37, 67, 91. U. S. G. S., 'Mineral Resources of the U. S.'; Bull. 603, p. 208. Bull. Dept. Geol. Univ. of Cal., Vol. 5, pp. 149–153, 331–380. Am. Jour. Sci., Vol. 31, p. 31.

The production of gem materials in California has been somewhat irregular and uncertain since 1911. The compilation of complete statistics is difficult owing to the widely scattered places at which stones are gathered and marketed for the most part in a small way. The materials reported in 1924 totaled $4,800 in value, compared with $13,220 in 1923; the decrease being due mainly to less activity in the tourmaline district of San Diego County.

The following table shows the distribution of rough, uncut gem and jeweler's materials during 1924:

County	Value	Kind
Butte	$225	Diamond, topaz, sapphire.
San Diego	1,925	Kunzite, tourmaline, spessartite and pyrope garnets, hyacinth, pink and aquamarine beryl, quartz.
Calaveras	*2,650	Quartz crystals.
Imperial		Dumortierite.
San Mateo		Jasper.
Total value	$4,800	

*Combined to conceal output of a single operator in each.

Varieties of California's Gem Stones.

Diamonds have been found in a number of localities in California; but in every case, they have been obtained in stream gravels while working them for gold. The principal districts have been: Volcano in Amador County; Placerville, Smith's Flat and others in El Dorado County; French Corral, Nevada County; Cherokee Flat, Morris Ravine, and Yankee Hill, Butte County; Gopher Hill and upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee in Butte County.

California *tourmalines* are decidedly distinctive in coloring and 'fire' as compared to foreign stones of this classification. The colors range from deep ruby to pink, and various shades of green; also a blue tourmaline has been found.

One of our California gem stones, *benitoite*, has not been found elsewhere; and in but a single locality here: The Dallas Mine in San Benito County.

Kunzite, a gem variety of spodumene, was first found in the Pala district in San Diego County. It has thus far been found in only one locality (Madagascar) outside of California. It is of a lilac color, and is described in detail in Bulletin 37 of the State Mining Bureau.

Beryls of excellent fire and delicate colors are also obtained in the Pala district, of which the *aquamarine* (blue) and *morganite* (pink) varieties deserve special mention. Morganite, like kunzite, has thus far been found elsewhere only in Madagascar.

Californite, or 'California jade,' is a gem variety of *vesuvianite*, and is green or white in color. It is found in Butte, Fresno, and Siskiyou counties.

Stones of precious blue *topaz* of fine quality are now being cut from crystals being mined in northern San Diego County. They are associated with beryl and blue tourmaline.

Some *rhodonite* has been mined in Siskiyou County, and used for decorative purposes, its value being included in the marble figures.

Chrysoprase has been produced in Tulare County.

Turquoise has been found in the desert section of San Bernardino County, but none produced commercially in recent years.

Sapphires have been reported recently found in San Bernardino and Riverside counties, but not as yet confirmed. A few have been found in stream gravels with diamonds in Butte County.

Rubies have been identified by the laboratory of the State Mining Bureau, occurring in limestone from the Baldy Mountains, San Bernardino County. Thus far no stones of commercial size have been taken out.

Total Production of Gem Materials in California.

The value of the gem output in California annually since the beginning of commercial production is as follows:

Year	Value	Year	Value
1900	$20,500	1913	$13,740
1901	40,000	1914	3,970
1902	162,100	1915	3,565
1903	110,500	1916	4,752
1904	136,000	1917	3,049
1905	148,500	1918	650
1906	497,090	1919	5,425
1907	232,642	1920	36,056
1908	208,950	1921	10,954
1909	193,700	1922	1,312
1910	237,475	1923	13,220
1911	51,824	1924	4,800
1912	23,050		
		Total value	$2,163,824

GRAPHITE.

Bibliography: State Mineralogist Reports XIII, XIV, XV, XVII. Bulletins 67, 91. U. S. G. S., Min. Res., 1914, Pt. II.

Graphite has been produced from time to time in the state, coming principally from Sonoma and Los Angeles counties. It is difficult for these deposits, which must be concentrated, to compete with foreign supplies, which go on the market almost directly as they come from the deposit. Graphite ores are concentrated with considerable difficulty, and the electric process of manufacturing artificial graphite from coal has been perfected to such a degree that only deposits of natural graphite of a superior quality can be exploited with any certainty of success.

According to the U. S. Geological Survey, operators in this country who are working disseminated flake deposits must depend on their No. 1 and 2 flake for their profit. Graphite dust is merely a by-product and is salable only at a low price. Improved methods of graphite milling adopted promise to increase largely the production of flake of better grade.

The principal value of graphite is on account of its infusibility and resistance to the action of molten metals. It is also largely used in the manufacture of electrical appliances, of 'lead' pencils, as a lubricant, as stove polish, paints, and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, etc., the low-grade material is satisfactory. Among the interesting uses for graphite is the prevention of formation of scale in boilers. The action is a mechanical one, being soft and slippery, the graphite prevents the particles of scale

from adhering to one another or to the boiler and they are thus easily removed.

The price increases with the grade of material, the best quality crystalline variety being quoted at present (f.o.b. New York) at 8½¢–9¢ per pound (Ceylon lumps).

The coarser flakes are necessary for crucibles, as they help to bind the clay together in addition to their refractory service. Imports in 1924 from Ceylon, Canada, Madagascar, Mexico and Korea, totaled 16,380 short tons valued at $399,511 compared with 19,817 tons valued at $606,336 in 1923.

Occurrence of graphite has been reported at various times from Calaveras, Fresno, Imperial, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma and Tuolumne counties.

During 1923–1924 there was no commercial output of graphite in California. For several years past, a single plant in Los Angeles County has been concentrating graphite from a disseminated ore, the product being used for paint and for foundry facing.

Graphite Production of California, by Years.

According to the records of the State Mining Bureau, the graphite production of California, by years, has been as follows:

Year	Pounds	Value
1901	128,000	$4,480
1902	84,000	1,680
1903		
1913	2,500	25
1914		
1915		
1916	29,190	2,335
1917		
1918	*770,000	37,225
1919		
1920		
1921	*624,000	26,160
1922		
1923		
Totals	1,637,690	$71,905

*Annual details concealed under 'Unapportioned,' on account of a single producer.

GYPSUM.

Bibliography: Reports XIV, XV, XVII, XVIII, XXI. Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 223, 413, 430, 697.

During 1924, one operator each in Imperial, Riverside, and San Bernardino counties produced a total of 25,569 tons of gypsum valued at $53,210 compared with 86,410 tons worth $188,336 in 1923. The material was utilized mainly in cement manufacture as a retardant, for hard-wall plaster, and for fertilizer. The considerable drop from the record figure of 1923 was due to smaller shipments from both Imperial and San Bernardino counties. The property of the Imperial Gypsum and Oil Company in western Imperial County has been taken over by the Pacific Portland Cement Co., Consolidated, and there is promise for a considerable increase in output for the coming year.

Uses.

The most important use of gypsum from the quantity standpoint is in the calcined form where it is utilized in the manufacture of various hard-wall plasters and plaster board. As plaster of paris, it plays a very important part in surgical work. Approximately 2% of raw gypsum is added in the manufacture of Portland cement just before the final grinding. In this application, the gypsum acts as a retarder to the set of the cement. The use of gypsum tile for non-bearing fireproof partitions, stairway and elevator enclosures, and the protection of steel columns, girders and beams, has increased greatly.

Land plaster may be applied to the soil by drilling, or scattered in the hill, or it may be sowed broadcast, in quantities ranging from 200 to 500 pounds to the acre.

Total Production of Gypsum in California.

Production of gypsum annually in California since such records have been compiled by this Bureau is as follows:

Year	Tons	Value	Year	Tons	Value
1887	2,700	$27,000	1907	8,900	$57,700
1888	2,500	25,000	1908	34,600	155,400
1889	3,000	30,000	1909	30,700	138,176
1890	3,000	30,000	1910	45,294	129,152
1891	2,000	20,000	1911	31,457	101,475
1892	2,000	20,000	1912	37,529	117,388
1893	1,620	14,280	1913	47,100	135,050
1894	2,446	24,584	1914	29,734	78,375
1895	5,158	51,014	1915	20,200	48,953
1896	1,310	12,580	1916	33,384	59,533
1897	2,200	19,250	1917	30,825	56,840
1898	3,100	23,600	1918	19,695	37,176
1899	3,663	14,950	1919	19,813	50,579
1900	2,522	10,088	1920	20,507	92,535
1901	3,875	38,750	1921	37,412	78,875
1902	10,200	53,500	1922	47,084	188,336
1903	6,914	46,441	1923	86,410	289,136
1904	8,350	56,592	1924	25,569	53,210
1905	12,859	54,500			
1906	21,000	69,000	Totals	706,621	$2,509,018

INFUSORIAL and DIATOMACEOUS EARTH.

Bibliography: State Mineralogist Reports II, XII–XVI (inc.), XV, XVII–XIX (inc.) Bulletins 38, 67, 91. Am. Inst. Min. Eng., Bull. 104, August, 1915, pp. 1539–1550. U. S. Bur. of Mines, Rep. of Investigations: Serial No. 2431, Jan., 1923. Eng. & Min. Jour.-Press, Vol. 115, pp. 1152–1154, June 30, 1923.

Infusorial and diatomaceous earths—sometimes called tripolite—are very light and extremely porous, chalk-like materials composed of pure silica (chalk, being calcareous) which have been laid down under water and consist of the remains of microscopical infusoria and diatoms. The former are animal remains, and the latter are from plants. The principal commercial use of this material is as an absorbent. It is also employed in the manufacture of scouring soap and polishing powders; for filtration purposes; in making some classes of refractory brick; and as an insulating medium both in heating and refrigeration. It is a

first-class nonconductor of heat, where high temperatures are employed, such as around steel and gas plants and power houses. In such cases, it is built in as an insulating layer in furnace walls. In Germany, under the name 'kieselguhr,' it was used as an absorbent for nitroglycerine in the early manufacture of dynamite.

As a nonconductor of heat it has been used alone or with other materials as a covering for boilers, steam pipes, and safes and in fireproof cements. It is used largely by paint manufacturers as a wood filler. Boiled with shellac it is made into records for talking machines. It has been used for absorbing liquid manures so that they could be utilized as fertilizers, and as a source of silica in making water-glass as well as in the manufacture of cement, tile glazing, artificial stone, ultramarine and other pigments of aniline and alizarine colors, paper filling, sealing wax, fireworks, hard-rubber objects, matches, and papier maché, and for solidifying bromide. For making insulating brick the material is sawed into blocks, and for all other purposes it is ground and screened.

The most important deposits in California thus far known are located in Monterey, Orange, San Luis Obispo, and Santa Barbara counties. The Santa Barbara material is diatomaceous and is of a superior quality, particularly for filtration uses which bring the higher prices. Infusorial or diatomaceous earths are also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma, and Tehama counties.

As practically 90% of the output in California is from a single operator, we have concealed the exact figures under the 'Unapportioned' item in the state and county totals. There were seven operators in 1924 in Los Angeles, Monterey, Santa Barbara, and Shasta counties.

The material shipped was utilized for insulation, filtration, paint pigment, and for clarification of gasoline and kerosene.

Total Production of Diatomaceous Earth in California.

The first recorded production of these materials in California occurred in 1889; total amount and value of output, to date, are as follows:

Year	Tons	Value	Year	Tons	Value
1889	39	$1,335	1908	2,950	$32,012
1890	----------	----------	1909	500	3,500
1891	----------	----------	1910	1,843	17,617
1892	----------	----------	1911	2,194	19,670
1893	50	2,000	1912	4,129	17,074
1894	51	2,040	1913	8,645	35,968
1895	----------	----------	1914	12,840	80,350
1896	----------	----------	1915	12,400	62,000
1897	5	200	1916	15,322	80,649
1898	----------	----------	1917	24,301	127,510
1899	----------	----------	1918	35,963	189,459
1900	----------	----------	1919	40,200	217,800
1901	----------	----------	1920	60,764	1,056,260
1902	422	2,532	1921	*90,739	1,016,675
1903	2,703	16,015	1922		
1904	6,950	112,282	1923	*	----------
1905	3,000	15,000	1924	*	----------
1906	2,430	14,400			
1907	2,531	28,948	Totals	330,971	$3,151,296

*Annual details concealed under 'Unapportioned.'

LIMESTONE.

Bibliography: State Mineralogist Reports IV, XII–XV (inc.), XVII–XXI (inc.). Bulletins 38, 91. Oregon Agr. College, Extension Bulletin 305. Eng. and Min. Jour.-Press, Vol. 120, pp. 249–253.

'Industrial' limestone was produced in twelve counties during 1924, to the amount of 219,476 tons, valued at $582,660, being an increase both in quantity and value over the 1923 output of 143,266 tons, worth $348,464.

The amount here given does not include the limestone used in the manufacture of cement nor for macadam and concrete, nor of lime for building purposes; but accounts for that utilized as a smelter and foundry flux, for glass and sugar making, and other special chemical and manufacturing processes. It also includes that utilized for fertilizers (agricultural 'lime'), 'roofing gravel,' paint and concrete filler, whiting for paint, putty, kalsomine, terrazzo, paving dust, chicken grit, carbon dioxide gas, 'paving compound,' facing dust for concrete pipe, also for rubber and magnesite mix. That indicated in the table below as coming from Santa Clara and Los Angeles counties is calcareous marl sold for agricultural purposes. Of the total product in 1924 approximately 24,000 tons valued at $85,000 was used for agricultural purposes.

Distribution of the 1924 output was as follows:

County	Tons	Value
El Dorado	112,156	$322,995
San Bernardino	14,375	45,137
Shasta	28,097	36,480
Tuolumne	8,515	19,983
Contra Costa, Inyo, Los Angeles, Santa Clara, Santa Cruz, Siskiyou, Tulare, Ventura*	56,333	158,065
Totals	219,476	$582,660

*Combined to conceal output of a single operator in each.

Limestone Production of California, by Years.

The following tabulation gives the amounts and value of 'industrial' limestone produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. These tonnages consist principally of limestone utilized for flux, glass and sugar making, agricultural, chemical, and other special industrial purposes. That utilized in cement manufacture is not included.

Year	Tons	Value	Year	Tons	Value
1894	15,420	$19,275	1910	684,635	$581,208
1895	71,355	71,690	1911	516,398	452,790
1896	68,184	71,112	1912	613,375	570,248
1897	36,796	38,556	1913	301,918	274,455
1898	27,686	24,548	1914	572,272	517,713
1899	30,769	29,185	1915	146,324	156,288
1900	32,791	31,532	1916	187,521	217,733
1901	76,937	99,445	1917	237,279	356,396
1902	71,422	90,524	1918	208,566	456,258
1903	125,919	163,988	1919	88,291	248,145
1904	40,207	87,207	1920	90,120	298,197
1905	192,749	323,325	1921	75,921	305,912
1906	80,262	162,827	1922	84,382	282,181
1907	230,985	406,041	1923	143,266	348,464
1908	273,890	297,264	1924	219,476	582,660
1909	337,676	419,921			
			Totals	5,882,792	$7,985,088

LITHIA.

Bibliography: State Mineralogist Reports II, IV, XIV, XXI. Bulletins 38, 67, 91.

Lithia mica, lepidolite (a silicate of lithium et al.) utilized in the manufacture of artificial mineral water, fireworks, glass, etc. has been mined in San Diego County since 1899, except between 1905 and 1915. Some amblygonite, a lithium phosphate, is occasionally also obtained from pockets associated with the gem tourmalines. In 1924 a total of 109 tons valued at $2,269 was shipped, in which was included a small tonnage of amblygonite. The lepidolite was utilized in glass manufacture.

Lithia mica total production in the state has been as follows:

Year	Tons	Value	Year	Tons	Value
1899	124	$4,600	1917	880	$8,800
1900	440	11,000	1918	4,111	73,998
1901	1,100	27,500	1919	800	14,400
1902	822	31,880	1920	10,046	153,502
1903	700	27,300	1921	*1,365	20,781
1904	641	25,000	1922		
1905	25	276	1923		
1906			1924	109	2,269
1915	91	1,365	Totals	21,325	$403,736
1916	71	1,065			

*Annual details concealed under 'Unapportioned.'

MICA.

Bibliography: State Mineralogist Reports II, IV. Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 740; Min. Res. of U. S. Eng. & Min. Jour.-Press, Vol. 115, pp. 55–60, Jan. 13, 1923.

No commercial production of mica has recently been reported in California. Production in previous years has been as follows:

Year	Tons	Value
1902	50	$2,500
1903	50	3,800
1904	50	3,000
Totals	150	$9,300

Classification and Uses.

Practically all marketable mica is of the muscovite or phlogopite varieties. There are three main commercial classes: Sheet mica, including punch; splittings, and scrap. Sheet mica is used chiefly for electrical purposes and for glazing; splittings are made into built-up mica; scrap is ground to a powder. Mica to be classified as sheet must yield a rectangle of at least 1½ x 2 in., must split evenly and freely, be free from cracks, rulings, or plications, and reasonably free from inclusions of foreign matter, though stains of a nonconducting character are permissible for some uses. Ability to withstand heat and high electrical resistance have led to a wide application of sheet mica in the electrical industries. The electrical uses of sheet mica greatly exceed all others in quantity and value of the material used.

As a heat-resisting transparent medium, sheet mica has various uses. It is widely employed for stove windows, though this use has declined to a considerable extent. A hard and rigid mica that is nearly clear is best suited for stove fronts. High-grade stove mica commands a higher price than electrical mica, because for the most part larger sizes are demanded. Mica is also used in furnace and bake-oven sight-holes, heat screens, lamp chimneys, canopies and shades, particularly for gas mantles, and also for military lanterns and in lantern slides.

Its ability to withstand shocks and strains, combined with its transparency, has led to wide use in motor goggles, spectacles, diver's helmets, smoke helmets, compass cards, gage fronts, and in windows subject to shock, as in the conning towers of warships. On account of its heat-resisting qualities, ground mica is used in railroad car axle packings, in pipe and boiler coverings, in fire-proof paints, and in rubber tires. Ground mica is used as a component in roofing, as a filler in rubber and other products, in calico printing, and as a tire powder. It is used also in tinsel decorations, and as 'Santa Claus snow' for Christmas tree and window decorations. It is used as a lubricant for wooden bearings, and mixed with oil for metal bearings.

MINERAL PAINT.

Bibliography: State Mineralogist Reports XII–XIX (inc.), XXI. Bulletins 38, 91.

Mineral paint materials were produced in California in 1924 from a total of three properties in Placer and Stanislaus counties, amounting to 532 tons valued at $5,234. This is a decrease from the 1,049 tons and $11,773 of 1923. The material shipped from Placer County is hematite, and that from Stanislaus, yellow ochre. Red ochre has been shipped from Sonoma and Ventura counties, in former years.

Mineral Paint Production of California, by Years.

The first recorded production of mineral paint materials in the state was in the year 1890. The output, showing annual amount and value, since that time, is given herewith:

Year	Tons	Value	Year	Tons	Value
1890	40	$480	1908	335	$2,250
1891	22	880	1909	305	2,325
1892	25	750	1910	200	2,040
1893	590	26,795	1911	186	1,184
1894	610	14,140	1912	300	1,800
1895	750	8,425	1913	303	1,780
1896	395	5,540	1914	132	847
1897	578	8,165	1915	311	1,756
1898	653	9,698	1916	643	3,960
1899	1,704	20,294	1917	520	2,700
1900	529	3,993	1918	728	4,738
1901	325	875	1919	1,780	17,055
1902	589	1,533	1920	779	8,477
1903	2,370	3,720	1921	446	4,748
1904	270	1,985	1922	1,620	13,277
1905	754	4,025	1923	1,049	11,773
1906	250	1,720	1924	532	5,234
1907	250	1,720			
			Totals	20,273	$193,882

MINERAL WATER.

Bibliography: State Mineralogist Reports VI, XII–XVIII (inc.)., XXI. U. S. G. S., Water Supply Paper 338. Min. Res. 1914, 1916. 'Mineral Springs and Health Resorts of California,' by Dr. Winslow Anderson. 1890. U. S. Dept. of Agr., Bur. of Chem., Bulletin 91.

A widespread production of mineral water is shown annually in California. These figures refer to mineral water actually bottled for sale, or for local consumption. Water from some of the springs having a special medicinal value brings a price many times higher than the average shown, while in some cases the water is used merely for drinking purposes and sells for a nominal figure. Health and pleasure resorts are located at many of the springs. The waters of some of the hot springs are not suitable for drinking, but are very efficacious for bathing.

From a therapeutic standpoint, California is particularly rich in mineral springs. The counterparts of many of the world-famed spas of Europe and the eastern United States can be found here. Radioactivity has been noted in at least two localities in California: At The Geysers in Sonoma County, and Arrowhead Hot Springs in San Bernardino County. It doubtless exists at others, but the State Mining Bureau has not as yet had funds available to conduct the necessary investigations along this line.

Commercial production of mineral water in California for 1924 amounted to a total of 8,159,211 gallons valued at $818,726, being an increase both in quantity and value over the high-record figures of 1923. The 1924 output was distributed by counties, as follows:

Mineral Water Production, by Counties, 1924.

County	Gallons	Value
Butte	6,000	$4,500
Calaveras	1,400	139
Lake	66,420	59,423
Los Angeles	1,889,285	88,942
Napa	73,608	53,391
Riverside	78,560	23,021
San Diego	107,097	8,642
Siskiyou	300,500	6,100
Sonoma	31,003	8,002
Colusa, Contra Costa, Humboldt, Marin, Monterey, Placer, San Benito, San Bernardino, San Luis Obispo, Santa Barbara, Santa Clara, Solano*	5,605,338	566,566
Totals	8,159,211	$818,726

*Combined to conceal output of a single operator in each.

The production above tabulated was in part bottled with artificial carbonation, in part natural and a large part was used in the preparation of soft drinks with flavors.

Although some of the operators complain that prohibition has all but killed off the mineral water business, the reports of actual production of mineral water bottled and sold indicate an encouraging growth and a material increase annually both in total quantity and value, as may be noted from the tabulation below.

Mineral Water Production of California, by Years.

Mineral water was bottled for sale, at the Napa Soda Springs, Napa County, as early as 1860, and at other springs in California, notably The Geysers, Sonoma County, also at early dates; but there are no figures available earlier than the year 1887. Amounts and values, annually, since that year are shown herewith:

Year	Gallons	Value	Year	Gallons	Value
1887	618,162	$144,368	1907	2,924,269	$544,016
1888	1,112,202	252,990	1908	2,789,715	560,507
1889	808,625	252,241	1909	2,449,834	465,488
1890	258,722	89,786	1910	2,335,259	522,009
1891	334,553	139,959	1911	2,637,669	590,654
1892	331,875	162,019	1912	2,497,794	529,384
1893	383,179	90,667	1913	2,350,792	599,748
1894	402,275	184,481	1914	2,443,572	476,169
1895	701,397	291,500	1915	2,274,267	467,738
1896	808,843	337,434	1916	2,273,817	410,112
1897	1,508,192	345,863	1917	1,942,020	340,566
1898	1,429,809	213,817	1918	1,808,791	375,650
1899	1,338,537	406,691	1919	2,233,842	340,117
1900	2,456,115	268,607	1920	2,391,791	421,613
1901	1,555,328	559,057	1921	3,446,278	367,476
1902	1,701,142	612,477	1922	4,276,346	486,424
1903	2,056,340	558,201	1923	5,487,276	616,919
1904	2,430,320	496,946	1924	8,159,211	818,726
1905	2,194,150	538,700			
1906	1,585,690	478,186	Totals	78,737,999	$15,357,336

PHOSPHATES.

Bibliography: State Mineralogist Report XXI. Bulletins 67, 91.

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithium phosphate, amblygonite, Li (AlF) PO_4, have been found associated with the gem tourmaline deposits in San Diego County. Such production has been classified under lithia.

PUMICE and VOLCANIC ASH.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XVIII. Bulletin 38 (See 'Tufa').

The production of pumice and volcanic ash for the year 1924 amounted to 4919 tons valued at $33,404 and came from properties in Imperial, Inyo, and Kern counties. This is an increase both in tonnage and value over the 1922 shipments. The material from Imperial County is of the vesicular, block variety and was sold for abrasive purposes; that from Inyo and Kern is the volcanic ash, or tuff variety, and was employed in making soap and cleanser compounds.

Commercial production of pumice in California was first reported to the State Mining Bureau in 1909, then not again until 1912, since which

year there has been a small annual output, as indicated by the following table:

Year	Tons	Value	Year	Tons	Value
1909	50	$500	1918	2,114	$28,669
1910			1919	2,388	43,657
1911			1920	1,537	25,890
1912	100	2,500	1921	406	6,310
1913	3,590	4,500	1922	613	4,248
1914	50	1,000	1923	2,936	16,309
1915	380	6,400	1924	4,919	33,404
1916	1,246	18,092			
1917	525	5,295	Totals	20,854	$196,774

PYRITES.

Bibliography: State Mineralogist Reports XVIII, XIX. Bulletins 38, 91. Min. and Sci. Press, Vol. 114, pp. 825, 840.

A total production of 124,214 short tons of pyrites, valued at $517,835, was reported shipped in California during 1924, from properties operated in Alameda, Mariposa, and Shasta counties. This was a decrease both in tonnage and value from the figures of 148,004 tons and $555,308 in 1923. The material was mostly used in the manufacture of sulphuric acid for explosives and fertilizers, but a portion was utilized directly in the preparation of agricultural fertilizer and insecticide. The sulphur content ranged up to 46.9% S.

This does not include the large quantities of pyrite, chalcopyrite and other sulphides which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates while under treatment for their precious metal values.

Pyrites Production in California, by Years.

The total recorded pyrites production in California to date is as follows:

Year	Tons	Value	Year	Tons	Value
1898	6,000	$30,000	1912	69,872	$203,470
1899	5,400	28,620	1913	79,000	218,537
1900	3,642	21,133	1914	79,267	230,058
1901	4,578	18,429	1915	92,462	293,148
1902	17,525	60,306	1916	120,525	372,969
1903	24,311	94,000	1917	111,325	323,704
1904	15,043	62,992	1918	128,329	425,012
1905	15,503	63,958	1919	147,024	540,300
1906	46,689	145,895	1920	146,001	530,581
1907	82,270	251,774	1921	110,025	473,735
1908	107,081	610,335	1922	151,381	570,425
1909	457,867	1,389,802	1923	148,004	555,308
1910	42,621	179,862	1924	124,214	517,835
1911	54,225	182,354	Totals	2,390,184	$8,395,192

SHALE OIL.

Bibliography: State Mineralogist Report XIX. U. S. Geol. Surv., Bulletins 322, 729. U. S. Bur. of Mines, Bull. 210. Eng. and Min. Jour.-Press, Vol. 118, No. 8, pp. 290–292, Aug. 23, 1924. Chem. & Met. Eng., Vol. 32, No. 6, Feb., 1925. Min. Congress Jour., Dec., 1924.

Oil shale is defined by Gavin[1] as follows:

"Oil shale is a compact, laminated rock of sedimentary origin, yielding over 33 per cent of ash and containing organic matter that yields oil when distilled, but not appreciably when extracted with the ordinary solvents for petroleum.

* * * * * * * * * *

"Oil shales contain a substance, or substances, usually classed as a pyro-bitumen, that by destructive distillation, or pyrolysis, yields oils somewhat similar to petroleum. These substances have been termed 'kerogen,' from two Greek words meaning producer of wax."

The Scottish oil shales are also known as 'torbanite.'

The so-called 'oil shales' of California do not for the most part conform to the above definition, as the greater part of the oil obtained from them occurs as such and can be extracted by suitable solvents. The most extensive deposits in this State are part of the Monterey formation of Tertiary age, and physically and chemically are different from the oil shales of Scotland and from other oil shales in the United States. The mineral matter of this shale is diatomaceous; the beds that yield oil occur in massive formation; and when freshly broken smell strongly of petroleum. Most geologists consider the Monterey shales to have been the origin of the oil in some of the oil fields of California.

Although the extraction of shale oil has been a matter of commercial practice on a considerable scale for many years in Scotland, France, and Australia, it has not attained any great commercial importance as yet in the United States. Technical knowledge of the subject, however, is increasing. With the gradual depletion of the underground reserves of liquid oil, it is merely a matter of time until the development of the oil shales of the United States will be an economic necessity. The selling price of petroleum will be the determining factor. The recovery of by-product ammonium sulphate is an important feature of the process.

Two plants on a more or less experimental scale have been in operation in California the past three or four years, with commercial production beginning in a small way in 1922. The product, in part, has been sold for utilization as a flotation oil in metallurgical work, and part has been consumed as fuel at the plants. Both plants report output for 1924, the amount and value being concealed under the 'unapportioned' item.

SILICA (Sand and Quartz).

Bibliography: State Mineralogist Reports IX, XIV, XV, XVII, XVIII, XX, XXI. Bulletins 38, 67, 91.

We combine these materials because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and

[1]Gavin, M. J., Oil shale, an historical, technical, and economic study: U. S. Bur. of Mines, Bull. 210, p. 26, 1924.

that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

A portion of the tonnage of vein quartz in California in 1916 and 1917 was employed in the preparation of ferro-silicon by the electric furnace. At present, some is utilized as a foundry flux, and for steel-casting moulds. A portion of the silica sold (both sand and quartz) is also used in glazes for porcelain, pottery and tile, and in the body of the ware to diminish shrinkage; and some of the sand for the preparation of sodium silicate ('water glass'). Manufacturers of paint use finely ground silica, which forms as much as one-third of the total pigment in some paints. For certain purposes finely-ground crystalline material is superior in paints to other materials because of the angularity of the grains, which makes them adhere more firmly to the article painted and after wear afford a good surface for repainting. The same angularity makes artificially comminuted crystalline quartz superior to natural sand for use in wood fillers. It is also preferable for soaps and polishing powders. Part of the 1924 output was used for roofing and stucco-dash granules.

We do not include under this heading such forms of silica as: quartzite, sandstone, flint, tripoli, diatomaceous earth, nor the gem forms of 'rock crystal,' amethyst, and opal. Each of these has various industrial uses, which are treated under their own designations.

The production of silica in California in 1924 amounted to 6,808 tons valued at $35,006, from eight properties in four counties.

Of the above total 548 tons was of sand, and 6260 tons of vein and boulder quartz. For making the higher grades of glass, most of the sand is imported from Belgium. There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the state: Alameda, Amador, El Dorado, Los Angeles, Monterey, Orange, Placer, Riverside, San Diego, San Joaquin, and Tulare, the chief centers being Amador, Monterey, and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass: for such, it must be essentially iron-free. Even a fractional per cent of iron imparts a green color to the glass.

Belgium sand is also displacing local material in the manufacture of sodium silicate ('water glass'), causing the closing down of operations in 1923 of the sand plant of the Philadelphia Quartz Company in Amador County.

Total Silica Production of California.

Total silica production in California since the inception of the industry, in 1899, is shown below, being mainly sand:

Year	Tons	Value	Year	Tons	Value
1899	3,600	$3,500	1913	18,618	$21,899
1900	2,200	2,200	1914	28,538	22,688
1901	5,000	16,250	1915	28,964	34,322
1902	4,500	12,225	1916	20,880	48,908
1903	7,725	7,525	1917	19,376	41,166
1904	10,004	12,276	1918	23,257	88,930
1905	9,257	8,121	1919	18,659	101,600
1906	9,750	13,375	1920	25,324	96,793
1907	11,065	8,178	1921	10,569	49,179
1908	9,255	22,045	1922	9,874	31,016
1909	12,259	25,517	1923	7,964	30,420
1910	19,224	18,265	1924	6,808	35,006
1911	8,620	8,672			
1912	13,075	15,404	Totals	343,705	$775,480

SILLIMANITE and ANDALUSITE.

Bibliography: State Mineralogist Report XX. Bulletins 67, 91. Dana's Mineralogy. U. S. Geol. Surv., Prof. Paper 110. Eng. & Min. Jour.–Press, Vol. 120, pp. 91–94, 1925.

Sillimanite and andalusite are both aluminum silicates (Al_2SiO_5), having the same composition and formula, but with slightly different physical characteristics. Though both crystallize in the orthorhombic system, their crystal habits are different: Andalusite being usually in coarse prismatic forms, the prisms nearly square in shape; also occurs massive, imperfectly columnar, and sometimes radiated and granular. Sillimanite commonly occurs in long, slender crystals, not distinctly terminated; prismatic faces striated and rounded; often in close parallel groups, passing into fibrous and columnar massive forms, sometimes radiating. Colors are similar. Hardness, andalusite 7.5, sillimanite 6–7. Andalusite is slightly lighter in specific gravity.

A massive deposit of andalusite, found in Dry Creek Canyon in the White Mountains of the Inyo Range, in Mono County, is being mined by the Champion Porcelain Company of Detroit, Michigan. The material is shipped East and utilized in the manufacture of porcelain for automobile spark plugs and for other high-tension electric insulators. The function and behavior of andalusite are described by Peck[1] in a recent paper, to which the reader is referred for details. This is

[1]Peck, A. B., Note on andalusite from California, a new use and some thermal properties: Cal. State Min. Bur., Mining in Cal., being April chapter, 1924, of State Mineralogist Report XX, pp. 149–154. Also: American Mineralogist, June, 1924.

apparently the only deposit of either andalusite or sillimanite thus far found in the United States at least in sufficient quantity to be of commercial consequence. Commercial shipments began in 1922, but as there is only the one operator, the annual tonnages and values are concealed under the 'unapportioned' item.

Cyanite is also an aluminum silicate (Al_2SiO_5), of the same chemical composition as andalusite and sillimanite, but crystallizing in the triclinic system. Occurs usually in long-bladed crystals, rarely terminated; hardness 5–7.25; gravity 3.56–3.67 (being heavier than the other two); color, blue. A deposit of cyanite, apparently in quantity, has been located in Imperial County, near Ogilby, but as yet no shipments made except for experimental purposes. If its physical and chemical behavior prove to be similar to andalusite, it too will have commercial possibilities.

SOAPSTONE and TALC.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII–XXI. Bulletins 38, 67, 91. U. S. Bur. of Mines, Bulletin 213. Rep. of Investigations, Serial No. 2253, May, 1921.

The total output of talc and soapstone in California in 1924 amounted to 16,179 tons valued at $242,770, compared with 17,439 tons valued at $252,661 in 1923. More than three-fourths of the product was high-grade talc from Inyo and San Bernardino counties, which material was utilized mainly in toilet powders, paint, paper, and rubber manufacture, and in part in magnesite stucco and flooring. The 'soapstone' grades were used mainly for roofing and as a filler in roofing paper, and part also in magnesite cement.

It is reported that California talc is steadily replacing imported talc in the toilet trade on the basis of quality. The largest production of talc in the United States comes from Vermont and New York, and of massive soapstone from Virginia.

Composition and Varieties.

Talc is hydrous magnesium silicate with the chemical formula $H_2Mg_3(SiO_3)_4$. It is also called soapstone, and steatite. The term 'talc' properly includes all forms of the pure mineral, whereas 'steatite' denotes particularly the massive, compact variety, and 'soapstone' the impure, massive forms containing as low as 50% of talc. When pure, talc is soft, having a hardness of 1, but impurities increase the hardness up to 3 or 4. The color varies from pure white and silvery white through gray, green, apple green, to dark green, also yellow, brown, and reddish when impure. It is commonly compact or massive, or in fine granular aggregates, and often in foliated plates or in fibrous aggregates.

Uses.

Although the uses of talc and soapstone are many and varied, some of them are not in general well known nor fully developed; and although few of their uses can justly be considered essential in the sense that no substitutes can be used, there are several which are of

great importance. The widest use of talc is in the powdered form, and the value depends upon color (whiteness), uniformity, fineness of grain, freedom from grit, 'slip,' and sometimes freedom from lime. The white varieties, free from grit and iron, low in lime, ground to 200-mesh and finer, are largely used as a filler for paper, rubber and paint, and the very highest grade as toilet powder. Ground talc is also used in dressing and coating cloth, in making soap, rope, twine, pipe-covering compounds, heavy lubricants, and polishes. Ground talc and soapstone are used for foundry facings, either alone or mixed with graphite; and a coarser grade is used in the manufacture of asphalt-coated roofing felts and papers, both as a filler and as a surfacing. Massive close-grained talc, free from iron and grit, is cut into blanks and baked, forming the material used for gas tips and electrical insulation, commercially known as 'lava.' Its hardness, its resistance to heat, acids and alkalies, and its great dielectric strength make it very useful for electric insulation, and no satisfactory substitute for it has been found.

Massive varieties of talc, pyrophyllite, and high grades of soapstone are cut into slate pencils and steel-workers' crayons. 'French chalk' or 'tailor's chalk' is a soft, massive talc. In China, Japan and India, massive talc (steatite) is carved into grotesque images and other forms, and is often sold as imitation jade. Soapstone is usually cut into slabs of 1 to 2 inches in thickness and sold as griddles, footwarmers, and fireless-cooker stones, or fabricated into laundry sinks and tubs, laboratory-table tops, hoods, tanks and sinks, electric switchboards, and for other uses in which the properties of resistance to heat, acids, and alkalies, and electricity are essential.

A detailed description of the classification and uses of talc and soapstone was given in the statistical report for 1922 (Bulletin 93) issued by the State Mining Bureau, copies of which are still available for distribution.

Imports.

Foreign importations of high-grade white talc suitable for the manufacture of toilet powder have come mainly from Canada, Italy and France. Foreign producers have the benefit of cheap labor, and a low tariff import duty. In addition to these disadvantages, California operators have to contend with transcontinental freight rates to the eastern manufacturing centers. In 1924 importations totaled 18,199 short tons valued at $356,629, compared with 19,988 tons valued at $425,277 in 1923, according to the United States Bureau of Foreign and Domestic Commerce.

Californian Production, 1924.

California's production of talc and soapstone in 1924 was distributed by counties as follows:

County	Tons	Value
Inyo	5,942	$98,806
San Bernardino	7,234	125,926
Butte, Calaveras, El Dorado*	3,003	18,038
Totals	16,179	$242,770

*Combined to conceal output of a single operator in each.

Talc Production of California, by Years.

Production has been intermittent in the state since 1893, as shown in the following table:

Year	Tons	Value	Year	Tons	Value
1893	400	$17,750	1910	740	$7,260
1894			1911		
1895	25	375	1912	1,750	7,350
1896			1913	1,350	6,150
1897			1914	1,000	4,500
1898			1915	1,663	14,750
1899			1916	1,703	9,831
1900			1917	5,267	45,279
1901	10	119	1918	11,760	85,534
1902	14	288	1919	8,764	115,091
1903	219	10,124	1920	11,327	221,362
1904	228	2,315	1921	8,752	130,078
1905	300	3,000	1922	13,378	197,18(
1906			1923	17,439	252,661
1907			1924	16,179	242,770
1908	3	48			
1909	33	280	Totals	102,304	$1,374,101

STRONTIUM.

Bibliography: Bulletins 67, 91. U. S. G. S., Bull. 540; 660–I.

There has been no production of strontium minerals in California since 1918, though in that year both celestite ($SrSO_4$), and the carbonate, strontianite ($SrCO_3$) were shipped. The first recorded commercial output of strontium minerals in California was in 1916. Th occurrence of the carbonate is particularly interesting and valuable, a it appears to be the first considerable deposit of commercial importanc so far opened up in the United States. Shipments reported as averag ing 80% $SrCO_3$ have been made. The deposit is associated with deposi of barite, near Barstow, San Bernardino County. The carbonate ha also been found in massive form near Shoshone, Inyo County. In addition to Imperial County, celestite is found near Calico and Ludlow and in the Avawatz Mountains in San Bernardino County, but as y undeveloped.

Production of strontium minerals in California, by years, has been follows:

Year	Tons	Value
1916	57	$2,850
1917	3,050	37,(
1918	2,900	33,(
1919		
Totals	6,007	$72,(

The principal use for strontium in the United States is in the for of the nitrate in the manufacture of red flares, or Costen and Bengal lights and fireworks. Previous to 1914, the nitrate was imported from Germany, England, and Sicily. In Germany and Russia, strontium in the form of the hydroxide is used in the manufacture of beet sugar. It

is stated that strontia is more efficient and satisfactory in that process than lime, as it gives an additional recovery of 6% to 8%.

Of the two minerals, strontianite (carbonate) and celestite (sulphate), the carbonate is the more desirable as it is easier to convert to other salts; but it is scarcer. Celestite is found with limestone and sandstone and is sometimes associated with gypsum. Strontianite is also found with limestone, but associated with barite and calcite.

SULPHUR.

Bibliography: State Mineralogist Reports IV, XIII, XIV. Bulletins 38, 67, 91.

In 1923–1924 there was a small production of sulphur, from a single property in Kern County. It was ground, and utilized as a fertilizer and in dusting for mildew. This is the first commercial output of native sulphur in California for many years although this mineral has been found to some extent in Colusa, Imperial, Inyo, Kern, Lake, Sonoma, Tehama, and Ventura counties.

Sulphur was produced at the famous Sulphur Bank mine in Lake County, during the years 1865–1868 (inc.), totaling 941 tons, valued at $53,500; following which the property became more valuable for its quicksilver. The Elgin quicksilver mine, near Wilbur Springs, Colusa County, is a similar occurrence.

The principal sources in the United States are the stratified deposits in Louisiana and Texas, extraction being accomplished by a unique system of wells with steam pipes. It is stated that the three large companies operating there are capable of producing more than 1,000,000 tons annually in excess of our normal consumption in the United States, which averages about 600,000 tons. The mines at Freeport, Texas, are in a peculiarly favorable location in that they are practically at tidewater.

Formerly considerable sulphur was imported from Italy and from Japan; but the situation is now reversed, so that in 1924, a total of 481,814 long tons valued at $7,786,254 was exported from the United States, principally to Europe and Canada.

CHAPTER SIX.

SALINES.

Bibliography: State Mineralogist Reports III, XIV, XV, XVII–XX (inc.). Bulletin 24. Spurr and Wormser, "Marketing of Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

Under this heading are included borax, common salt, soda, potash, and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties. Except for a single year's absence, soda has had a continuous production since 1894. Potash, magnesium chloride and sulphate, and calcium chloride have been added to the commercial list in recent years, while the nitrates are still prospective.

Our main resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, and San Luis Obispo counties, and the waters of the Pacific Ocean.

The total value of this group shows a decrease to $4,374,192 in 1924 from the 1923 figure of $4,614,619, as detailed in the following tabulation:

Substance	1923		1924		Increase+ Decrease— Value
	Tons	Value	Tons	Value	
Borates	62,667	$1,893,798	52,070	$1,599,149	$294,649—
Magnesium salts	3,662	116,031	4,823	145,883	29,852+
Potash	29,597	709,836	33,107	747,407	37,571+
Salt	275,979	1,130,670	318,800	1,159,137	28,467+
Soda	34,885	764,284	32,536	711,796	52,488—
Unapportioned[a]				10,820	10,820+
Totals		$4,614,619		$4,374 192	
Net decrease					$240,427—

[a]Includes calcium chloride, aluminum sulphate, glauber salt, potash alum.

BORATES.

Bibliography: State Mineralogist Reports III, X, XII–XV (inc.), XVII–XXI (inc). Bulletins 24, 67, 91.

During 1924 there was produced in California a total of 93,273 tons of borate materials, compared with a total of 118,601 tons for the year 1923. The material shipped in 1924 included crude and selected colemanite ore from Inyo and San Bernardino counties varying from 18.6% to 26.9% anhydrous boric acid ("A.B.A."), also crystallized borax recovered by two plants from evaporation of brines at Searles Lake in San Bernardino County.

As the crude ore is not sold, as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric acid content, we have recalculated the tonnage to a basis of 40% A.B.A. This is approximately the average A.B.A. content of the colemanite material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

Recalculated as above, the 1924 production totals 52,070 tons valued at $1,599,149, a decrease from the similar figures for 1923 which were 62,667 tons and $1,893,798.

Colemanite is a calcium borate, and the material mined is shipped to seaboard chemical plants for refining. Refined 'borax' (sodium tetraborate) is used in making the enameled coating for cast-iron and steelware employed in plumbing fixtures, chemical equipment, and kitchen utensils. It is also a constituent of borosilicate glasses which are utilized in making lamp chimneys, baking dishes, and laboratory glassware. Other important uses of borax are in the manufacture of laundry and kitchen soaps, in starch, paper sizing, tanning, welding, and in the preparation of boric acid, which is employed as an antiseptic and in preserving meats.

Total Production of Borate Materials in California.

Borax was first discovered in California in the waters of Tuscan Springs in Tehama County, January 8, 1856. Borax Lake in Lake County, was discovered in September of the same year by Dr. John A. Veach. This deposit was worked in 1864–1868, inclusive, and during that time produced 1,181,365 pounds of refined borax. The bulk of it was exported by sea, to New York. This was the first commercial output of this salt in the United States, and California is still today the leading American producer of borax, having been for many years the sole producer.

Production from the dry lake 'playa' deposits of Inyo and San Bernardino counties began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds at Calico, in San Bernardino County. These have since been largely worked out, and the output for a number of years has been coming from similar beds in Inyo and Los Angeles counties. In 1920 San Bernardino County again entered the field with shipments of such ore from near Daggett. The colemanite deposits of Ventura County are at present unworked, owing to lack of transportation facilities. Some production of colemanite is being made from deposits recently opened up in Clarke County, Nevada.

The total production of borate materials in California is shown in the following table:

Year	Tons	Value	Year	Tons	Value
1864	12	$9,478	1895	5,959	$595,900
1865	126	94,099	1896	6,754	675,400
1866	201	132,538	1897	8,000	1,080,000
1867	220	156,137	1898	8,300	1,153,000
1868	32	22,384	1899	20,357	1,139,882
1869			1900	25,837	1,013,251
1870			1901	22,221	982,380
1871			1902	[a]17,202	2,234,994
1872	140	89,660	1903	34,430	661,400
1873	515	255,440	1904	45,647	698,810
1874	915	259,427	1905	46,334	1,019,158
1875	1,168	289,080	1906	58,173	1,182,410
1876	1,437	312,537	1907	53,413	1,200,913
1877	993	193,705	1908	22,200	1,117,000
1878	373	66,257	1909	16,628	1,163,960
1879	364	65,413	1910	16,828	1,177,960
1880	609	149,245	1911	50,945	1,456,672
1881	690	189,750	1912	42,135	1,122,713
1882	732	201,300	1913	58,051	1,491,530
1883	900	265,500	1914	62,500	1,483,500
1884	1,019	198,705	1915	67,004	1,663,521
1885	942	155,430	1916	103,523	2,409,375
1886	1,285	173,475	1917	109,944	2,561,958
1887	1,015	116,689	1918	88,772	1,867,908
1888	1,405	196,636	1919	66,791	1,717,192
1889	965	145,473	1920	127,065	2,794,206
1890	3,201	480,152	1921	50,136	1,096,326
1891	4,267	640,000	1922	[b]39,087	1,068,025
1892	5,525	838,787	1923	62,667	1,893,798
1893	3,955	593,292	1924	52,070	1,599,149
1894	5,770	807,807	Totals	1,427,749	$48,420,657

[a]Refined borax. [b]Recalculated to 40% 'anhydrous boric acid' equivalent beginning with 1922.

CALCIUM CHLORIDE.

Bibliography: U. S. Geol. Surv., Min. Res. 1919. Pt. II. Engineering and Contracting, Roads & Streets monthly issue, Feb. 6, 1924. 'How to Maintain Roads,' manual of instruction of Dow Chemical Company.

Calcium chloride is hygroscopic, that is, it has an affinity for water. This property is taken advantage of by utilizing this salt as a drying agent. It is also sprinkled on dirt roads and playgrounds to keep down dust by absorbing moisture. In refrigerating machinery for ice factories, meat-packing houses and cold-storage warehouses, a calcium-chloride solution is stated to have some advantages over salt brine. In fire buckets this solution has an advantage over pure water, in that it has a lower freezing point, does not corrode metal, and tends to keep the buckets full due to its absorbing moisture from the atmosphere. Powdered calcium chloride is used in drying gases, fruits and vegetables.

For dust prevention on roads, it is stated that the flake form of the chloride gives better results than the granulated. Immediately after spreading, the flake begins to absorb moisture from the air—"in fact, absorbs three times its weight in water, dissolves itself into the surface

material of the road, remains there, holds the moisture and prevents dust." It is recommended that the first application in the spring should be made as soon as the roads are partly dried and the spring rains over, in order to prevent the accumulation of the first dust during the season. From 1 to 2 pounds of flake chloride are used per square yard according to the nature of the road surface. Ordinarily a second application, of from ½ to 1 pound per square yard, should follow in from four to six weeks depending upon conditions; and sometimes a light, third application may be necessary during a long, dry summer. The most satisfactory method for applying large quantities of flake calcium chloride is to use an agricultural lime or fertilizer spreader attached by a short tongue to the rear of a truck. Excellent results are reported with the following kinds of road surfaces: gravel, water-bound gravel, water-bound macadam, sand-clay, clay-sand, cinders, mine tailings. It can not be used to advantage on roads of heavy clay, oil-treated surfaces, heavy rolling sand, or the ordinary dirt road which is composed almost entirely of fine dead material. The last named should first have a resurfacing or application of gravel.

A very important and growing use for calcium chloride is its application to curing concrete pavements instead of the slower and more expensive earth and water-covering method. It is stated that one application of the flake chloride will absorb a sufficient amount of moisture from the air to keep the pavements wet continuously 24 hours per day when properly applied. As soon as the newly laid concrete has taken on enough set to permit an application without marring the surface, the chloride should be spread on at the rate of 2 to 2½ pounds per square yard, depending upon the dryness of the weather. It should be evenly spread. There is no need of applying an earth covering and hence no subsequent earth removal, and no extra water pumping, thereby eliminating these items of expense. Not only that, but experience has proved that the time of set for the concrete is shortened by use of the chloride, so that pavements so treated can be opened to traffic in one-half the time required if cured by ponding or by earth and water. In the case of patching broken pavements, if calcium chloride is mixed in with the concrete as laid, in proper proportions, and a further application spread on the finished surface, the patched pavement can be opened to traffic in 48 hours without injury to the concrete.

Californian Production.

Commercial production of calcium chloride in California was first reported to the State Mining Bureau in 1921, from two plants in San Bernardino County, being obtained as a by-product in the refining of salt from deposits in certain of the desert dry lakes. In 1922–1924, there was only a single operator, so that the annual details are concealed under the 'unapportioned' item.

Year	Tons	Value
1921	683	$22,980
1922	1,204	26,580
1923		
1924	*	------
Totals	1,887	$49,560

*Annual details concealed under 'unapportioned,' on account of a single producer.

MAGNESIUM SALTS.

Bibliography: Reports XX, XXI. Bulletin 91. 'Dictionary of Applied Chemistry,' by Thorpe. U. S. Geol. Surv., Min. Res. of U. S.

The production of magnesium chloride and sulphate in California during 1924 totaled 4,823 tons, valued at $145,883, an increase both in quantity and value over the 1923 figures of 3,662 tons and $116,031. This was nearly all chloride, sold for use in magnesite stucco and cement mixtures (Sorel cement), and with one exception, was prepared from residual bitterns at salt plants in Alameda, Los Angeles, San Diego, and San Mateo counties. It was in part marketed in the liquid form. The exception consisted of a natural sulphate shipped from one of the desert dry lakes in Inyo County by the American Magnesium Company and refined at their plant at Wilmington. The sulphate marketed was utilized for medicinal and bath purposes.

With the use of magnesite cement and stucco coming more into prominence in building construction on the Pacific Coast, the demand for magnesium chloride is increasing here; but the domestic article has to meet the competition of the cheaper, imported German chloride.

The average value reported for the chloride produced in California in 1924 was approximately $29 per ton, f.o.b. plant.

Total Production of Magnesium Salts in California.

Commercial production of magnesium chloride in California was begun in 1916 by some of the salt companies, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride. In addition, some magnesium sulphate, or 'epsom salts' is also made, annually, but in smaller amount.

The total production of magnesium salts in California, since the beginning of the industry here, is shown in the following tabulation:

Year	Tons	Value
1916	851	$6,407
1917	1,064	34,973
1918	1,008	29,955
1919	1,616	82,457
1920	3,150	107,787
1921	4,153	106,140
1922	3,036	89,788
1923	3,662	116,031
1924	4,823	145,883
Totals	23,363	$719,421

NITRATES.

Bibliography: Report XV. Bulletins 24, 67, 91. U. S. G. S., Press Bulletin No. 373, July, 1918.

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the state, but no deposit of commercial value has been developed as yet. It is hoped that a closer search may some day be rewarded by workable discoveries. At present the principal commercial source of nitrates is the Chilean saltpeter (sodium nitrate) deposits in South America.

The fixation of atmospheric nitrogen electrically has been accomplished successfully in Germany and Scandinavia. The possibilities of cheap hydro-electric power in California make the subject one of interest to us, as we have also the natural raw materials and chemicals to go with the power. Sodium and potassium cyanides can be made by fixation of atmospheric nitrogen electrically.

POTASH.

Bibliography: Reports XV, XVIII, XX. Bulletins 24, 67, 91. U. S. G. S., Min. Res. 1913, 1914, 1915. Senate Doc. No. 190, 62d Congress, 2d Session. Mining & Sci. Press, Vol. 112, p. 155; Vol. 114, p. 789. Eng. and Min. Jour.-Press, Vol. 117, p. 557, Apr. 5, 1924.

During 1924, a total of 33,107 tons of potash salts of all grades was produced in California valued at $747,407, compared with 29,597 tons and $709,836 in 1923. This included potassium chloride from salt-works bitterns and from Searles Lake brine, and sulphate from portland-cement dust. The quality varied from 30% to 61.25% equivalent K_2O content, these salts being produced at plants in Alameda, San Bernardino, San Mateo, and Santa Cruz counties. The product sold was utilized mainly for the manufacture of fertilizers, and some for caustic potash (KOH).

Imports of crude potash into the United States in 1924, according to the U. S. Geological Survey, amounted to 692,250 short tons, containing 200,365 short tons of K_2O, valued at $13,376,282. Of this amount 663,914 tons of crude potash, containing 187,079 short tons of K_2O, valued at $10,042,575 were salts used mainly in the fertilizer industry. Germany and France are the foreign sources of supply.

According to MacDowell[1]

"The principal potash salts used in commercial fertilizer mixtures and the basis on which they are sold are as follows:

	Purity in per cent	Sold on basis in per cent	Form
Muriate of potash	80-85	80 KCl	Potassium chloride
Sulphate of potash	90-95	90 K_2SO_4	Potassium sulphate
Double manure salt	48-53	48 K_2SO_4	Potassium sulphate
Manure salt	30	30 K_2O	Double salt of magnesium and potassium chloride
Manure salt	20	20 K_2O	Double salt of magnesium and potassium chloride
Kainite	12.4 K_2O		Mostly potassium chloride

"The above salts are in crystallized form, of standard analysis. In the higher grades of muriate and sulphate, material is in the form of very fine crystals barely detectable by the eye. In the lower grades of manure salt and kainite the crystals are larger, the material being ground to pass a 4-mesh screen.

* * * * * * * * *

"The records of the Potash Syndicate in Germany indicate that production of K_2O during the last eight years varied from 356,056 metric tons in 1915 to 614,834 metric tons in 1922. These figures represent minimum and maximum yearly production.

"Prices on potash for fertilizers over a period of years, exclusive of the war, have been maintained on a fairly uniform basis. The net cost to the manufacturer over a period of years has not varied, excepting during the war, as much as other raw materials. Kainite testing 12.4 per cent of potash has varied from $5.50 to $9 per ton; 20 per cent manure salts from $7.50 to $12 per ton; muriate from $30 to $36 per ton, basis 80 per cent; sulphate from $40 to $46 per ton, basis 90 per cent. At the present time the Germans have a practical monopoly on the manufacture of sulphate of potash, as little kieserit is found in the Alsatian field. Owing to the

[1]MacDowell, C. H., Marketing of potash: Eng. & Min. Jour.-Press, Vol. 117, p. 558, Apr. 5, 1924.

high cost of fuel and labor, they have recently increased the price $2.25 per ton. During the war, domestic potash sold at from $4 to $5 a unit K_2O, German muriate as high as $500 a ton and sulphate at $400 a ton. There is no indication on the sellers' part of raising prices still further, and unless the German and French producers reach an agreement, which does not now seem probable, the potash requirements of the fertilizer industry seem assured for the present at a comparatively low price."

Other uses for potash salts, besides those noted above, are in the manufacture of the best liquid soap and some higher-grade cake soaps, of some finer grades of glass, and in matches. The chemical requirements include tanning, dyeing, metallurgy, electroplating, photography, and medicine.

Total Production of Potash in California.

Potash production began commercially in California in 1914, with a small yield from kelp. Considerable time and money has been spent on research work incident to developing deposits of potash-bearing residues and brines in the old lake beds of the desert regions, and production there has been accomplished on a commercial scale at plants on Searles Lake, San Bernardino County. Some is also made annually from salt-works bitterns, and from portland-cement dust, as above noted.

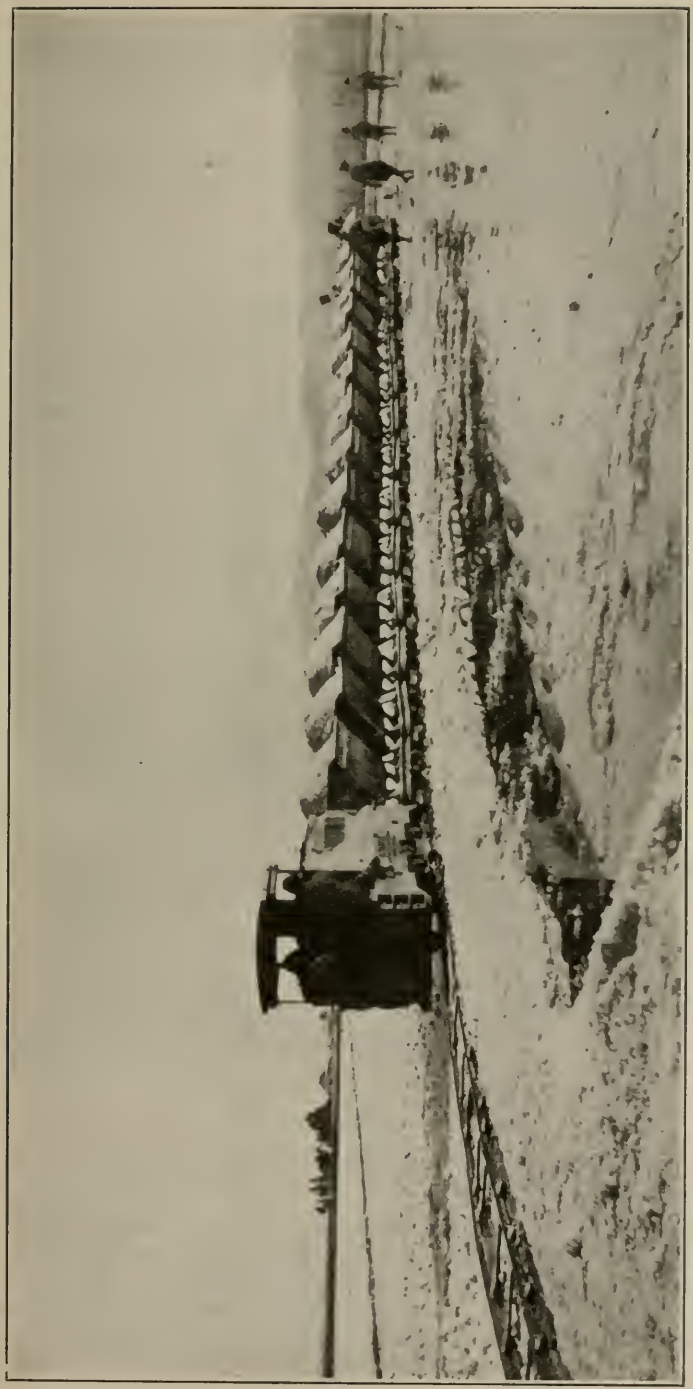
The annual amounts and value of these potash materials, since their beginning in California in 1914, are shown by the following table:

Year	Tons	Value
1914	10	$460
1915	1,076	19,391
1916	17,908	663,605
1917	129,022	4,202,889
1918	49,381	6,808,976
1919	28,118	2,415,963
1920	26,298	1,465,463
1921	14,806	390,210
1922	17,776	584,388
1923	29,597	709,836
1924	33,107	747,407
Totals	347,099	$18,014,588

SALT.

Bibliography: State Mineralogist Reports II, XII–XV (inc.), XVII–XXI (inc.); Bulletins 24, 67, 91. U. S. Geol. Surv., Bull. 669. U. S. Bur. of Mines, Bull. 146.

Most of the salt production in California is obtained by evaporating the water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions, mainly in Kern and San Bernardino counties. A small amount of valuable medicinal salts is obtained by evaporation of the water of Mono Lake, Mono County.



Hauling salt from ponds of Leslie Salt Refining Company, San Mateo County. Photo by courtesy of the company.

Distribution of the 1924 salt production of California, by counties, was as follows:

County	Tons	Value
Alameda	189,217	$635,653
Kern	10,506	44,115
San Bernardino	29,699	99,791
San Mateo	52,258	205,176
Los Angeles, Modoc, Mono[a], Monterey, San Diego*	35,120	174,402
Totals	318,800	$1,159,137

[a]Medicinal salts. *Combined to conceal output of a single operator in each.

The above returns show an increase both in tonnage and value over the 1923 figures, establishing a new high record for this industry in California. There were nine plants operating in Alameda County, and a total of twelve plants in the other counties tabulated, being an increase of three over the total number operated in 1923.

Production of Salt in California, by Years.

Amount and value of annual production of salt in California from 1887 is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	28,000	$112,000	1907	88,063	$310,967
1888	30,800	92,400	1908	121,764	281,469
1889	21,000	63,000	1909	155,680	414,708
1890	8,729	57,085	1910	174,920	395,417
1891	20,094	90,303	1911	173,332	324,255
1892	23,570	104,788	1912	185,721	383,370
1893	50,500	213,000	1913	204,407	462,681
1894	49,131	140,087	1914	223,806	583,553
1895	53,031	150,576	1915	169,028	368,737
1896	64,743	153,244	1916	186,148	455,695
1897	67,851	157,520	1917	227,825	584,373
1898	93,421	170,855	1918	212,076	806,328
1899	82,654	149,588	1919	233,994	896,963
1900	89,338	204,754	1920	230,638	972,648
1901	126,218	366,376	1921	197,989	832,702
1902	115,208	205,876	1922	223,238	819,187
1903	102,895	211,365	1923	275,979	1,130,670
1904	95,968	187,300	1924	318,800	1,159,137
1905	77,118	141,925			
1906	101,650	213,228	Totals	4,905,327	$14,368,130

SODA.

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XX; Bulletins 24, 67, 91. U. S. Geol. Surv. Bull. 717.

The production of natural carbonates and sulphate of sodium in California in 1924 included: soda ash and bicarbonate from plants at Owens Lake, Inyo County; trona ('sesqui-carbonate,' a double salt of Na_2CO_3 and $NaHCO_3$) from Searles Lake, San Bernardino County; and salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County. The total amounted to 32,536 tons, valued at $711,796, being

a slight decrease both in tonnage and value from the 1923 figures of 34,885 tons and $764,284.

The dense ash and bicarbonate were used in the manufacture of soap, sal soda, glass, and chemicals; the salt cake in glass making; and the trona for neutralizing in flotation concentration.

Sodium compounds to some extent replace potassium compounds, in glass and soap making, in photography, in match making, in tanning, and in the manufacture of cyanide for extracting gold and silver from their ores.

Soda Production of California, by Years.

The total output, showing amount and value of these materials in California since the inception of the statistical records of the State Mining Bureau, is given in the table which follows:

Year	Tons	Value	Year	Tons	Value
1894	1,530	$20,000	1910	8,125	$11,862
1895	1,900	47,500	1911	9,023	52,887
1896	3,000	65,000	1912	7,200	37,094
1897	5,000	110,000	1913	1,861	24,936
1898	7,000	154,000	1914	6,522	115,396
1899	10,000	250,000	1915	5,799	83,485
1900	1,000	50,000	1916	10,593	264,825
1901	8,000	400,000	1917	24,505	928,578
1902	7,000	50,000	1918	20,447	855,423
1903	18,000	27,000	1919	21,294	721,958
1904	12,000	18,000	1920	32,407	1,164,898
1905	15,000	22,500	1921	14,828	438,996
1906	12,000	18,000	1922	20,084	573,661
1907			1923	34,885	764,284
1908	9,600	14,400	1924	32,536	711,796
1909	7,712	11,593			
			Totals	368,851	$8,008,072

CHAPTER SEVEN.

BY COUNTIES.

Introductory.

The State of California includes a total area of 158,360 square miles, of which 155,980 square miles are of land. The maximum width is 235 miles, the minimum, 148 miles; and the length from the northwest corner to the southeast corner is 775 miles. The state is divided into fifty-eight counties. The 1920 census figures show a total population for California of 3,437,709. A January, 1925, estimate based upon average daily attendance in elementary schools places the figure this year at approximately 5,000,000. Minerals of commercial value exist in every county, and during 1924 some active production was reported to the State Mining Bureau from all of the fifty-eight.

Of the first ten counties, in point of total output for 1924, the first three, Los Angeles, Kern, Orange, owe their position mainly to petroleum, as do also Fresno (fifth), Ventura (sixth), Santa Barbara (eighth). Los Angeles, due to its oil, leads all the others, being credited with 45% of the entire state's total for 1924, having passed Kern in 1923 which led for many years. San Bernardino (fourth) owes its place chiefly to cement, silver, potash, borax, mineral water, and tungsten; Riverside (seventh) to cement, stone, brick and tile; Shasta to copper, stone and pyrite; Santa Cruz to cement; Plumas to copper. Twenty-three counties have each a total in excess of a million dollars for 1924. Cement is an important item in seven of these counties, and magnesite in one. In point of variety and diversity, San Bernardino County led all the others in 1924, with a total of 21 different mineral products on its commercial list, followed by Inyo with 20; by San Diego and Riverside with 18 each; Los Angeles with 17; Kern, 16; Shasta, 14; Calaveras, 12; Placer, 11; Fresno, Monterey, Santa Barbara, Santa Clara, 10 each; Butte, Orange, Siskiyou, and Tuolumne, 9 each. The counties with their mineral resources, production for 1924, etc., are considered in detail in the following paragraphs.

Value of California's Mineral Production by Counties for 1924, Arranged in the Order of Their Importance.

	County	Value		County	Value
1.	Los Angeles	$168,420,709	31.	Trinity	$509,344
2.	Kern	74,164,451	32.	Tulare	498,674
3.	Orange	40,481,210	33.	Placer	492,180
4.	San Bernardino	12,642,431	34.	Humboldt	485,478
5.	Fresno	12,547,798	35.	El Dorado	395,572
6.	Ventura	6,089,394	36.	Napa	359,265
7.	Riverside	5,508,244	37.	Stanislaus	345,138
8.	Santa Barbara	5,159,740	38.	San Luis Obispo	317,779
9.	Shasta	4,754,664	39.	San Mateo	302,171
10.	Santa Cruz	4,339,233	40.	Monterey	286,490
11.	Plumas	3,876,105	41.	Mariposa	234,707
12.	Solano	3,089,475	42.	Sonoma	172,051
13.	Nevada	2,945,267	43.	San Francisco	150,258
14.	Amador	2,938,865	44.	Siskiyou	140,787
15.	Alameda	2,634,645	45.	Imperial	139,908
16.	Contra Costa	2,348,090	46.	Mono	126,691
17.	Sacramento	2,196,210	47.	Lake	96,396
18.	Yuba	2,189,881	48.	Merced	87,603
19.	San Benito	2,144,603	49.	Colusa	77,267
20.	Inyo	2,110,075	50.	Mendocino	60,768
21.	Calaveras	1,572,419	51.	Glenn	41,550
22.	Santa Clara	1,150,401	52.	Lassen	37,908
23.	San Diego	1,013,119	53.	Tehama	34,454
24.	Madera	955,469	54.	Yolo	15,800
25.	Sierra	812,476	55.	Alpine	2,552
26.	Del Norte	722,265	56.	Modoc	1,300
27.	Butte	641,750	57.	Kings	725
28.	Tuolumne	602,156	58.	Sutter	97
29.	San Joaquin	602,500			
30.	Marin	527,231		Total	$374,620,789

ALAMEDA.

Area: 843 square miles.
Population: 344,177 (1920 census).
Location: East side of San Francisco Bay.

Alameda County, while in no sense one of the 'mining counties,' comes fifteenth on the list with a value of mineral products for 1924 of $2,634,645, an increase over the 1923 total, which was $2,487,035. The mineral resources of this county include asbestos, brick, chromite, clay, coal, limestone, magnesite, manganese, potash, pyrite, salt, soapstone, and miscellaneous stone.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Brick and hollow tile		$763,476
Clay (pottery)	2,482 tons	1,124
Magnesium salts	997 tons	28,661
Salt	189,217 tons	635,653
Stone, miscellaneous		1,158,886
Other minerals*		46,845
Total value		$2,634,645

*Includes potash and pyrites.

ALPINE.

Area: 776 square miles.
Population: 243 (1920 census).
Location: On eastern border of state, south of Lake Tahoe.

Alpine has at times in the past shown a small production mainly of gold and silver. For 1924 the total value was $2,552 and included copper, lead, silver, and miscellaneous stone.

This county lies just south of Lake Tahoe, in the high Sierra Nevada range of mountains. Transportation is by auto, wagon, or mule back, and facilities in general are lacking to promote development work of any kind.

The mineral resources of this section are varied and the country has not yet been thoroughly prospected. Occurrences of barium, copper, gold, gypsum, lead, limestone, pyrite, rose quartz, silver, tourmaline, and zinc have been noted here.

AMADOR.

Area: 601 square miles.
Population: 7793 (1920 census).
Location: East-central part of state—Mother Lode district.

The value of Amador County's mineral production increased from $1,955,874 in 1923 to $2,938,865, placing it number fourteen on the list of counties in the state as regards total value of mineral substances marketed. The increase was due mainly to gold.

Although having an output consisting of 7 different minerals, the leading product, gold, makes up approximately 89% of the entire total.

Amador at one time led the state in gold production, though exceeded in 1920-1923 by Yuba and Nevada counties, but in 1924 by Nevada County only.

The mineral resources of this county include asbestos, brick, chromite, clay, coal, copper, gold, lime, quartz crystals, glass-sand, sandstone, silver, soapstone, and miscellaneous stone.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Clay (pottery)	64,317 tons	$87,444
Gold		2,706,508
Silver		18,251
Stone, miscellaneous		3,050
Other minerals*		123,612
Total value		$2,938,865

*Includes brick, coal, copper, lead.

BUTTE.

Area: 1722 square miles.
Population: 30,030 (1920 census).
Location: North-central portion of state.

Butte, twenty-seventh county in California in regard to the value of its mineral output, reported a commercial production of nine mineral substances, having a total value of $641,750 as compared with $841,948 in 1923. As will be noted in the following tabulation, gold is by far the most important item. Butte stands seventh among the gold-producing counties of the state. Among the mineral resources of this section are asbestos, barytes, chromite, gems, gold, limestone, marble, mineral water, platinum group, silver, and miscellaneous stone.

Commercial value for 1924 was as follows.

Substance	Amount	Value
Gems		$225
Gold		484,530
Mineral water	6,000 gals.	4,500
Platinum	20 fine oz.	2,829
Silver		2,118
Stone, miscellaneous		138,000
Other minerals*		9,548
Total value		$641,750

*Includes natural gas and soapstone.

CALAVERAS.

Area: 1027 square miles.
Population: 6183 (1920 census).
Location: East-central portion of state—Mother Lode district.

Calaveras County reported production of 12 different minerals, valued at $1,572,419 during the year 1924 as compared with the 1923 output of $1,498,119. Gold, copper, and silver are the chief mineral substances. In regard to total value of mineral output, Calaveras stands twenty-first among the counties of the state, and fifth in gold. The increase, as compared with 1923, is due mainly to copper.

The principal mineral resources developed and undeveloped are: Asbestos, chromite, clay, copper, fuller's earth, gold, limestone, marble,

mineral paint, mineral water, platinum group, pyrite, quartz crystals, silver, soapstone, and miscellaneous stone.

Commercial output for 1924 was as follows:

Substance	Amount	Value
Copper	4,724,441 lbs.	$618,902
Gold		853,961
Mineral water	1,400 gals.	139
Silver		7,463
Stone, miscellaneous		83,250
Other minerals*		8,704
Total value		$1,572,419

*Includes pottery clay, gems (quartz crystals), lead, platinum, silica (quartz), soapstone.

COLUSA.

Area: 1140 square miles.
Population: 9920 (1920 census).
Location: Sacramento Valley.

Colusa County lies largely in the basin of the Sacramento Valley. Its western border, however, rises into the foothills of the Coast Range of mountains, and its mineral resources—largely undeveloped—include coal, chromite, copper, gypsum, manganese, mineral water, pyrite, quicksilver, sandstone, miscellaneous stone, sulphur, and in some places traces of gold and silver.

The value of the 1924 production was $77,267, a slight increase over 1923 figures of $75,000, giving it forty-ninth place, and was as follows:

Substance	Value
Stone, miscellaneous	$75,167
Other minerals	2,100
Total value	$77,267

CONTRA COSTA.

Area: 714 square miles.
Population: 53,889 (1920 census).
Location: East side of San Francisco Bay.

Contra Costa, like Alameda County, lies on the eastern shores of San Francisco Bay, and is not commonly considered among the mineral-producing counties of the state. It stands sixteenth on the list in this respect, however, with an output valued at $2,348,090 for the calendar year 1924. Various structural materials make up the chief items, including brick, cement, limestone, and miscellaneous stone. Among the others are asbestos, clay, coal, gypsum, manganese, mineral water, and soapstone.

Commercial production for 1924 was as follows:

Substance	Value
Brick and hollow tile	$327,225
Stone, miscellaneous	646,369
Other minerals*	1,374,496
Total value	$2,348,090

*Includes clay (pottery), cement, limestone, mineral water.

DEL NORTE.

Area: 1024 square miles.
Population: 2759 (1920 census).
Location: Extreme northwest corner of state.
Transportation: Motor, wagon and mule back; steamer from Crescent City.

Del Norte almost rivals Alpine County in regard to inaccessibility. Like the latter county also, given transportation and kindred facilities, this portion of the state presents a wide field for development along mining lines especially. It chief mineral resources, largely untouched, are chromite, copper, gems, gold, iron, platinum group, silver, and miscellaneous stone.

The 1924 output was an increase over the figure of $34,027 in 1923, due to crushed rock used on highway construction, and to rock used on the Crescent City harbor jetty.

Commercial production for 1924, giving it twenty-sixth place, was as follows:

Substance	Value
Gold	$325
Stone, miscellaneous	721,720
Other minerals	220
Total value	$722,265

EL DORADO.

Area: 1753 square miles.
Population: 6426 (1920 census).
Location: East-central portion of the state, northernmost of the Mother Lode counties.

El Dorado County, which contains the locality where gold in California was first heralded to the world, comes thirty-fifth on the list of counties ranked according to the value of their total mineral production during the year 1924. In addition to the segregated figures here given, a large tonnage of limestone is annually shipped from El Dorado for use in cement manufacture, and whose value is included in the state total for cement. The increase over the 1923 figure of $216,065 was due to limestone.

The mineral resources of this section, many of them undeveloped, include asbestos, barytes, chromite, clay, copper, gems, gold, iron, molybdenum, limestone, quartz crystals, quicksilver, slate, soapstone, silver, and miscellaneous stone.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Gold		$28,207
Limestone	112,156 tons	322,995
Silver		153
Talc	1,498 tons	8,988
Stone, miscellaneous		2,538
Other minerals*		32,691
Total value		$395,572

*Includes copper and lime.

FRESNO.

Area: 5950 square miles.
Population: 128,779 (1920 census).
Location: South-central portion of state.

Fresno County, fifth in importance as a mineral producer among the counties of California, reported an output for 1924 of ten mineral substances, with a total value of $12,547,798, an increase from the reported 1923 production, which was worth $4,883,331.

The bulk of the above is derived from the petroleum production of the Coalinga field, with miscellaneous stone also important.

The mineral resources of this county are many, and, aside from crude oil, are in the main not fully developed. They include asbestos, barytes, brick, chromite, copper, gems, gold, graphite, gypsum, magnesite, natural gas, petroleum, quicksilver, and miscellaneous stone.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Brick and hollow tile		$95,014
Gold		32,978
Granite		60,447
Natural gas	1,430,708 M cu. ft.	102,286
Petroleum	10,156,405 bbls.	11,801,743
Silver		190
Stone, miscellaneous		451,540
Other minerals		3,600
Total value		$12,547,798

GLENN.

Area: 1259 square miles.
Population: 11,853 (1920 census).
Location: West side of Sacramento Valley.

Glenn County, standing fifty-first, owes its position among the mineral-producing counties of the state mainly to the presence of large deposits of sand and gravel which are annually worked, the product being used for railroad ballast, etc. In 1917 and 1918, chromite was also an important item. In the foothills in the western portion of the county, deposits of chromite, copper, manganese, sandstone, and soapstone have been found.

Commercial production for 1924 was as follows, being a decrease from the $113,282 of the previous year:

Substance	Value
Stone, miscellaneous	$41,550

HUMBOLDT.

Area: 3634 square miles.
Population: 37,857 (1920 census).
Location: Northwestern portion of state, bordering on Pacific Ocean.

Humboldt County is almost entirely mountainous, transportation within its limits being very largely by auto and wagon road, and trail, and until recent years was reached from the outside world by steamer only. The county is rich in mineral resources, among which are brick,

chromite, coal, clay, copper, gold, iron, mineral water, natural gas, petroleum, platinum, silver, and miscellaneous stone.

Eight mineral substances, as shown by the table given below, having a total value of $485,478 were produced in 1924, as compared with the 1923 output of $434,706, the increase being due to the large amount of rock being used in jetty construction at Humboldt Bay (Eureka Harbor). Humboldt ranks thirty-fourth among the counties of the state for the year.

Commercial production for 1924 was as follows:

Substance	Value
Gold	$1,269
Silver	7
Stone, miscellaneous	476,449
Other minerals*	7,753
Total value	$485,478

*Includes brick, pottery clay, mineral water, natural gas, platinum.

IMPERIAL.

Area: 4089 square miles.
Population: 43,383 (1920 census).
Location: Extreme southeast corner of the state.

During 1924 Imperial County produced eight mineral substances having a total value of $139,908, a decrease from the 1923 output of $264,733. Its rank is forty-fifth. This county contains deposits of cyanite, gold, gypsum, lead, manganese, marble, pumice, salt, silver, sodium, and strontium, largely undeveloped.

Commercial production for 1924 was as follows:

Substance	Value
Gold	$258
Silver	1
Stone, miscellaneous	78,032
Other minerals*	61,617
Total value	$139,908

*Includes brick, gems (dumortierite), gypsum, pumice.

INYO.

Area: 10,019 square miles.
Population: 7031 (1920 census).
Location: Lies on eastern border of state, north of San Bernardino County.

Inyo, the second largest county in the state, and containing less than one inhabitant per square mile, is extremely interesting from a mineralogical point of view. It is noted that because of the fact that within its borders are located both the highest point, Mount Whitney (elevation 14,502 feet), and the lowest point, Death Valley (elevation 290 feet below sea level), in the United States. In the higher mountainous sections are found many vein-forming minerals, and in the lake beds of Death Valley saline deposits exist.

Inyo's mineral production during the year 1924 reached a value of $2,110,075, standing twentieth among the counties of the state in this respect. Twenty different mineral substances were produced. The 1923 value was $2,845,581, the decrease being due mainly to lead. Its mineral resources include antimony, asbestos, barytes, borates, copper,

dolomite, gems, gold, gypsum, lead, marble, soda, sulphur, talc, tungsten, and zinc.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Copper	79,995 lbs.	$10,479
Dolomite	17,197 tons	37,491
Gold		19,977
Lead	4,813,718 lbs.	385,098
Silver		115,799
Talc	5,942 tons	98,806
Stone, miscellaneous		12,500
Other minerals*		1,429,925
Total value		$2,110,075

*Includes alum, borates, building stone (tuff), fuller's earth, glauber salt, lime, limestone, magnesium sulphate, pumice, radio galena crystals, soda (ash and bicarbonate), tungsten concentrates.

KERN.

Area: 8003 square miles.
Population: 54,843 (1920 census).
Location: South-central portion of state.

Kern County, because of its immensely productive oil fields, for many years stood preeminent among all counties of California in the value of its mineral output, the exact figures for 1924 being $74,164,451. Kern was surpassed by both Los Angeles and Orange counties in 1923, but by Los Angeles only in 1924, for which petroleum is also responsible. The 1923 mineral output for this county was worth $41,812,415. The increase was due to the higher prices for crude oil of all grades, and to the fact that a large number of wells in the San Joaquin Valley fields which had been 'shut in' owing to the over-production of high-gravity oil in the new gusher fields of the Los Angeles Basin, were again put on production in 1924. During 1924, sixteen different mineral substances were produced.

Among the mineral resources, developed and undeveloped, of this section are antimony, asphalt, borax, brick, clay, copper, fuller's earth, gems, gold, gypsum, iron, lead, limestone, magnesite, marble, mineral paint, natural gas, petroleum, potash, salt, silver, soapstone, soda, sulphur, and tungsten.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Brick and clay (pottery)		$23,058
Gold		154,132
Lime	8,130 tons	96,880
Natural gas	47,881,308 M cu. ft.	2,522,551
Petroleum	61,175,405 bbls.	69,572,934
Salt	10,506 tons	44,115
Silver		35,902
Stone, miscellaneous		5,244
Other minerals*		1,709,635
Total value		$74,164,451

*Includes arsenic, cement, copper, lead, pumice, sulphur.

KINGS.

Area: 1159 square miles.
Population: 22,031 (1920 census).
Location: South-central portion of the state.

Little development has taken place in Kings County along mineral lines to date. Deposits of fuller's earth, gypsum, mineral paint, natural

gas, and quicksilver, of undetermined extent, have been found in the county. Some drilling for oil has been under way, but there has, as yet, been no commercial output recorded.

Tulare Lake is in Kings County, though now largely drained, and the land under cultivation.

In fifty-seventh place, commercial mineral production in this county for 1924 was as follows:

Substance	Amount	Value
Natural gas	1,480 M cu. ft.	$725

LAKE.

Area: 1278 square miles.
Population: 5542 (1920 census).
Location: About fifty miles north of San Francisco Bay and the same distance inland from the Pacific Ocean.

On account of its topography and natural beauties, Lake County is sometimes referred to as the Switzerland of America. The mineral resources which exist here are many and varied, actual production being comparatively small, as shown by the table below, and in the past composed mainly of quicksilver and mineral water. Some of the leading minerals found in this section, in part as yet undeveloped, are borax, chromite, clay, copper, gems, gold, gypsum, mineral water, quicksilver, silver, and sulphur.

In forty-seventh place, commercial production for 1924 was as follows:

Substance	Amount	Value
Mineral water	66,420 gals.	$59,423
Stone, miscellaneous		22,833
Other minerals*		14,140
Total value		$96,396

*Includes natural gas and quicksilver.

LASSEN.

Area: 4531 square miles.
Population: 8507 (1920 census).
Location: Northeast portion of state.

Lassen County is one of the little-explored sections of California. Since about 1912 a railroad traversing the county north and south has been in operation, thus affording opportunity for development along mineral and other lines.

Among the mineral resources of this county are copper, gems, gypsum, gold, silver, and sulphur. In the past, some gold had been produced, but not for some years, until 1921, when the yield again became important. In fifty-second place, commercial production for 1924 was as follows:

Substance	Value
Gold	$2,250
Silver	44
Stone, miscellaneous	35,614
Total value	$37,908

LOS ANGELES.

Area: 4067 square miles.
Population: 936,438 (1920 census).
Location: One of the southwestern coast counties.

Mineral production in Los Angeles County for the year 1924 amounted in value to $168,420,709 as compared with the 1923 output, worth $174,367,459. This accounts for practically 45% of the entire state's total for 1924, and ranks Los Angeles County first in the state as a mineral producer, having in 1923 passed Kern County which had been leading for several years. The advance was due to the large increase in the petroleum yield, and also in part to an increase in the output of bricks, hollow building tile, natural gas, and miscellaneous stone. The slight drop in 1924 was due to petroleum.

Its output of brick and tile was over five million dollars, and that of petroleum amounted to over one hundred and forty-seven million dollars. Among the mineral resources may be noted asphalt, barytes, borax, brick, clay, fuller's earth, gems, gold, gypsum, infusorial earth, limestone, marble, mineral paint, mineral water, natural gas, petroleum, salt, glass-sand, sandstone, serpentine, silver, soapstone, and miscellaneous stone. Some potash has been obtained from kelp.

Commercial production for 1924, consisting of 17 substances, was as follows:

Substance	Amount	Value
Brick	301,957 M	$5,030,259
Building tile (hollow)	46,941 tons	454,728
Clay (pottery)	84,065 tons	132,855
Gold		751
Mineral water	1,889,285 gals	88,942
Natural gas	122,838,521 M cu. ft.	9,191,395
Petroleum	119,027,428 bbls.	147,474,953
Silver		5,515
Stone, miscellaneous		5,923,329
Other minerals*		117,982
Total value		$168,420,709

*Includes copper, building stone (tuff), diatomaceous earth, lead, limestone, magnesium chloride, salt.

MADERA.

Area: 2112 square miles.
Population: 12,203 (1920 census).
Location: East-central portion of state.

Madera County produced six different mineral substances during the year 1924, having a total value of $955,469, as compared with the 1923 output worth $518,035, the increase being due to granite. This county contains deposits of copper, gold, granite, iron, lead, molybdenum, pumice, silver, and building stone.

In twenty-fourth place, commercial production for 1924 was as follows:

Substance	Amount	Value
Copper	34,467 lbs.	$4,515
Gold		3,208
Granite		935,820
Silver		176
Stone, miscellaneous		11,750
Total value		$955,469

MARIN.

Area: 529 square miles.
Population: 27,342 (1920 census).
Location: Adjoins San Francisco on the north.

Mineral production in Marin County during 1924 amounted to $527,231, being a decrease from the 1923 figure of $688,881 due to crushed rock and brick. This county is not especially prolific in minerals, although among its resources along these lines are brick, gems, manganese, mineral water, soapstone, and miscellaneous stone.

In thirtieth place, commercial production for 1924 was:

Substance	Value
Stone, miscellaneous	$356,035
Other minerals*	171,196
Total value	$527,231

*Includes brick, pottery clay, mineral water.

MARIPOSA.

Area: 1463 square miles.
Population: 2775 (1920 census).
Location: Most southerly of the Mother Lode counties. East-central portion of state.

Mariposa County is one of the distinctly 'mining' counties of the state, although it stands but forty-first on the list of counties in regard to the value of its mineral output for 1924 with a total of $234,707, as compared with the 1923 figure of $170,911, the increase being due to gold and stone.

Its mineral resources are varied; among the more important items being barytes, copper, gems, gold, lead, marble, silver, slate, soapstone, and miscellaneous stone.

The Yosemite Valley is in Mariposa County.

Commercial production for 1924 was as follows:

Substance	Value
Gold	$182,099
Silver	1,608
Stone, miscellaneous	48,000
Other minerals	3,000
Total value	$234,707

MENDOCINO.

Area: 3453 square miles.
Population: 24,116 (1920 census).
Location: Joins Humboldt County on the south and bounded by the Pacific Ocean on the west.

Mendocino's annual mineral production has usually been small, the 1924 output being valued at $60,768, ranking it fiftieth among the counties. That of 1923 was worth $53,410.

Deposits of in part undetermined value of asbestos, chromite, coal, copper, graphite, magnesite, and mineral water have been found, as well as traces of gold, platinum, and silver.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Brick	550 M	$7,125
Stone, miscellaneous		49,680
Other minerals*		3,963
Total value		$60,768

*Includes coal, manganese, natural gas, platinum.

MERCED.

Area: 1995 square miles.
Population: 24,579 (1920 census).
Location: About the geographical center of the state.

Merced County as a whole lies in the San Joaquin Valley and it figures as one of the lesser mineral producing counties of the state. The 1924 mineral output was valued at $87,603 compared with $235,630 in 1923, the decrease being due to miscellaneous stone.

Gold, platinum, and silver were formerly obtained in important amounts by dredging, which ceased in this county in 1918, though a small yield from other sources still continues. Undeveloped deposits of antimony, magnesite, quicksilver, and limestone have been noted in this county in addition to the foregoing.

In forty-eighth place, commercial production during 1924 was as follows:

Substance	Value
Clay and clay products	$72,933
Gold	355
Silver	1
Stone, miscellaneous	14,262
Other minerals*	52
Total value	$87,603

*Includes copper and lead.

MODOC.

Area: 3823 square miles.
Population: 5425 (1920 census).
Location: The extreme northeast corner of the state.

Modoc County, like Lassen, has only in recent years had the benefit of communication with the outside world by rail. Among its known mineral resources are clay, coal, gold, iron, quicksilver, salt, and silver. In fifty-sixth place, commercial production for 1924 was as follows:

Substance	Value
Unapportioned*	$1,300

*Includes salt and miscellaneous stone.

MONO.

Area: 3030 square miles.
Population: 960 (1920 census).
Location: Is bordered by the State of Nevada on the east and is about in the central portion of the state measured on a north and south line.

Gold mining has been carried on in portions of Mono County for many years, although taken as a whole it lies in a somewhat inaccessible

country so far as rail transportation is concerned. It is in the continuation of the highly mineralized belt which was noted in Inyo County and contains among other mineral resources barytes, clay, copper, gold, limestone, molybdenum, pumice, salt, silver, and travertine.

In forty-sixth place, commercial production for 1924 was as follows:

Substance	Amount	Value
Gold		$49,651
Lead	32,458 lbs.	2,597
Silver		6,472
Stone, miscellaneous		19,044
Other minerals*		48,927
Total value		$126,571

*Includes copper, onyx, travertine, salt, sillimanite-andalusite.

MONTEREY.

Area: 3330 square miles.
Population: 27,980 (1920 census.)
Location: West-central portion of state, bordering on Pacific Ocean.

Monterey County produced ten mineral substances during the year 1924, having a total value of $286,490, as compared with the 1923 output worth $222,022, the increase being due to miscellaneous stone. Its mineral resources include brick, clay, copper, coal, diatomaceous earth, dolomite, feldspar, fuller's earth, gold, gypsum, limestone, mineral water, petroleum, quicksilver, glass-sand, sandstone, silver, and miscellaneous stone.

In fortieth place, commercial production for 1924 was as follows:

Substance	Amount	Value
Clay (pottery)	238 tons	$436
Dolomite	1,240 tons	4,960
Stone, miscellaneous		239,847
Other minerals*		41,247
Total value		$286,490

*Includes diatomaceous earth, mineral water, quicksilver, salt, shale building stone, silica (glass-sand).

NAPA.

Area: 783 square miles.
Population: 20,678 (1920 census).
Location: Directly north of San Francisco Bay—one of the 'bay counties.'

Napa, because of its production of structural and industrial materials and mineral water, stands thirty-sixth on the list of mineral-producing counties in California. Its mineral resources include chromite, copper, gypsum, magnesite, mineral water, quicksilver, sandstone, and miscellaneous stone. In the past this county has been one of the important producers of quicksilver.

In 1924 the value of the output increased to $359,265 over the 1923 figure of $351,592.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Mineral water	73,608 gals.	$53,391
Stone, miscellaneous		261,523
Other minerals*		44,351
Total value		$359,265

*Includes magnesite and quicksilver.

NEVADA.

Area: 974 square miles.
Population: 10,860 (1920 census).
Location: North of Lake Tahoe, on the eastern border of the state.

Nevada, one of the mountain counties of California, for some years alternated with Amador in the gold lead, but both were passed by Yuba in 1918–1921, also 1923. In 1922 and 1924 Nevada led. Nevada County stands thirteenth on the list in regard to value of its total mineral output with a figure of $2,945,267 as compared with the 1923 production worth $2,370,770. The increase is due to gold.

While this county actually produces mainly gold and silver, its resources cover a wide scope, including antimony, asbestos, barytes, bismuth, chromite, clay, copper, gems, iron, lead, mineral paint, pyrite, soapstone, and tungsten.

Commercial production for 1924 was as follows:

Substance	Value
Gold	$2,820,032
Silver	39,252
Stone, miscellaneous	82,200
Other minerals*	3,783
Total value	$2,945,267

*Includes copper, granite, lead.

ORANGE.

Area: 795 square miles.
Population: 61,375 (1920 census).
Location: Southwestern portion of state, bordering Pacific Ocean.

Orange County is one of the many in California which on casual inspection appears to be anything but a mineral producing section. It stood for several years, however, as the second county in the state in regard to the total value of mineral output, on account of its highly productive oil fields. It was passed in 1922 by Los Angeles, the credit for which is also due to oil, and in turn Orange passed Kern County in 1923, but dropped back to third in 1924.

This county shows a decrease in 1924, with a total value of mineral products of $40,481,210, compared to the 1923 output, worth $45,468,989 due to petroleum and natural gas. Orange passed Shasta County in 1917, which previously for a number of years had exceeded all other counties in California, except Kern.

Aside from the substances actually produced and noted in the table below, coal, gysum, iron, infusorial earth, sandstone, and tourmaline have been found in Orange County.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Brick and clay (pottery)		$121,260
Natural gas	29,812,139 M cu. ft.	2,397,813
Petroleum	31,661,283 bbls.	37,455,298
Stone, miscellaneous		505,932
Other minerals*		907
Total value		$40,481,210

*Includes copper, lead, silver.

PLACER.

Area: 1395 square miles.
Population: 18,584 (1920 census).
Location: Eastern border of state directly west of Lake Tahoe.

While standing only thirty-third on the list of mineral producing counties, Placer contains a wide variety of mineral substances, some of which have not been commercially exploited. Its leading products include gold, chromite, granite, copper, and clay. Other mineral resources are asbestos, brick, coal, gems, iron, lead, limestone, magnesite, manganese, marble, quartz crystals, glass-sand, silver, and miscellaneous stone.

Commercial production for 1924 was as follows, compared to a total value of $405,975 for the preceding year:

Substance	Amount	Value
Brick and hollow tile		$186,053
Clay (pottery)	97,670 tons	146,508
Gold		108,757
Granite		19,155
Silver		534
Stone, miscellaneous		15,573
Other minerals*		15,600
Total value		$492,180

*Includes mineral paint, mineral water, silica (quartz).

PLUMAS.

Area: 2594 square miles.
Population: 5681 (1920 census).
Location: Northeastern border of state, south of Lassen County.

A considerable portion of the area of Plumas County lies in the high mountains, and deposits of the metals, especially gold and copper, are found there. Mineral production for 1924 was valued at $3,876,105, as compared with the 1923 output, worth $3,784,262, the increase being due to gold. This placed the county eleventh in rank. In 1919 Plumas passed Shasta in the copper lead, owing to the Shasta smelters being closed down, which position Plumas still retains.

Among its mineral resources are chromite, copper, gold, granite, iron, lead, limestone, manganese, molybdenum, platinum, silver, and zinc.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Copper	25,557,362 lbs	$3,348,015
Gold		277,571
Silver		247,569
Other minerals*		2,950
Total value		$3,876,105

*Includes chromite and granite.

RIVERSIDE.

Area: 7240 square miles.
Population: 60,297 (1920 census).
Location: Southern portion of state.

Riverside is the fourth county in the state in size and the seventh in regard to the total value of mineral output for 1923. Within its borders are included mountain, desert, and agricultural land. Its mineral

resources include metals, structural and industrial materials and salines, some of the more important being brick, cement, clay, coal, copper, feldspar, gems, gold, gypsum, iron, lead, limestone, manganese, magnesite, marble, mineral paint, mineral water, salt, soapstone, silver, miscellaneous stone and tin. In point of variety Riverside County showed eighteen different minerals commercially produced in 1924. The increase in 1924 over the 1923 value of $7,093,853 was due to cement.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Brick and hollow tile		$493,746
Clay (pottery)	121,193 tons	166,692
Copper	8,899 lbs.	1,166
Feldspar	2,205 tons	20,162
Gold		1,070
Granite		17,680
Lead	26,817 lbs.	2,145
Mineral water	78,560 gals.	23,021
Silica (quartz)	3,160 tons	24,579
Silver		581
Stone, miscellaneous		561,861
Other minerals*		4,195,541
Total value		$5,508,244

*Includes cement, coal, gypsum, mica schist.

SACRAMENTO.

Area: 983 square miles.
Population: 90,978 (1920 census).
Location: North-central portion of state.

Sacramento stands seventeenth among the counties of the state as a mineral producer, the output, principally gold, for 1924, being valued at $2,196,210, as compared with the 1923 production, worth $2,436,015. In regard to gold output alone, this county ranks fourth, being exceeded only by Yuba, Nevada and Amador counties, the Sacramento product coming from the dredges. Its mineral resources include brick, clay, gold, granite, natural gas, platinum, silver, and miscellaneous stone.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Brick and hollow tile		$290,213
Clay (pottery)	1,750 tons	4,470
Gold		1,150,687
Granite		11,150
Silver		1,753
Stone, miscellaneous		639,811
Other minerals*		98,126
Total value		$2,196,210

*Includes natural gas and platinum.

SAN BENITO.

Area: 1392 square miles.
Population: 8995 (1920 census).
Location: West-central portion of state.

Although nineteenth among the counties of the state in regard to value of total mineral production, San Benito has led for some years in one important branch of the mineral industry, namely, quicksilver. Cement is also an important item.

Its other mineral resources, many of them undeveloped, include antimony, asbestos, bituminous rock, chromite, coal, dolomite, gems, gypsum, limestone, magnesite, mineral water, and miscellaneous stone.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Quicksilver	4,670 flasks	$320,758
Stone, miscellaneous		269,369
Other minerals*		1,554,476
Total value		$2,144,603

*Includes asbestos, cement, coal, dolomite, magnesite, mineral water.

SAN BERNARDINO.

Area: 20,157 square miles.
Population: 73,401 (1920 census).
Location: Southeastern portion of state.

San Bernardino, by far the largest county in the state in area, ranks fourth as regards the value of its mineral output for 1924 with a total of $12,642,431, as compared with the 1923 total of $13,777,253. The decrease is due mainly to cement and silver.

San Bernardino for several years (except 1918) has led all other counties in the state in point of variety of minerals, producing commercially during 1924 a total of 21 different substances. This county also ranks first as a silver producer in the state, from the mines of the Randsburg district. In fact, the California Rand mine, there, has been the largest single silver producer in the United States for the past four years.

This county, consisting largely of mountain and desert country, is highly mineralized, the following being included among its resources: Asbestos, barytes, borax, brick, cement, clay, copper, gems, gold, granite, gypsum, iron, lead, limestone, manganese, marble, mineral paint, mineral water, nitre, potash, salt, soapstone, soda, miscellaneous stone, strontium, talc, tungsten, vanadium, and zinc.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Cement	4,354,119 bbls.	$7,571,370
Copper	17,667 lbs.	2,314
Gold		187,573
Lead	31,668 lbs.	2,533
Limestone	14,375 tons	45,137
Salt	29,699 tons	99,791
Silver		1,531,598
Talc	7,234 tons	125,926
Stone, miscellaneous		355,946
Other minerals*		2,720,243
Total value		$12,642,431

*Includes borates, clay (pottery), calcium chloride, fuller's earth, gypsum, lime, mineral water, petroleum, potash, soda (trona), tungsten concentrates.

SAN DIEGO.

Area: 4221 square miles.
Population: 112,248 (1920 census).
Location: Extreme southwest corner of state.

San Diego ranks twenty-third in the total value of its mineral output and gained third place in point of variety with a record of eighteen different commercial minerals for the year. The value for 1924 equaled $1,013,119, as compared with the 1923 output worth $821,776.

In 1918 for the only time in several years there was no production of gems, in which San Diego County has led the state. Aside from minerals commercially produced, as shown below, San Diego County contains occurrences of bismuth, lithia, marble, nickel, soapstone, and tin. Potash has been produced from kelp.

A development of recent years is the shipping of pebbles for grinding mills.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Brick and hollow tile		$232,113
Clay (pottery)	12,783 tons	36,941
Feldspar	6,850 tons	47,950
Gems		1,925
Gold		4,830
Granite		94,006
Lithia	109 tons	2,269
Mineral water	107,097 gals.	8,642
Silver		97
Stone, miscellaneous		379,094
Other minerals*		205,252
Total value		$1,013,119

*Includes arsenic, fuller's earth, lime, magnesium chloride, salt.

SAN FRANCISCO.

Area: 43 square miles.
Population: 506,676 (1920 census).

Surprising as it may appear at first glance, San Francisco County is listed among the mineral producing sections of the state, actual production consisting mainly of crushed rock, sand and gravel. Small quantities of various valuable mineral substances are found here, including cinnabar, gypsum, lignite, and magnesite, none, however, in paying quantities. Some pumice has been produced.

In forty-third place, commercial production for 1924 was as follows:

Substance	Value
Stone, miscellaneous	$150,258

SAN JOAQUIN.

Area: 1448 square miles.
Population: 79,905 (1920 census).
Location: Central portion of state.

San Joaquin County reported a mineral production for the year 1924 having a total value of $602,500, as compared with the 1923 output worth $811,229.

Comparatively few mineral substances are found here, the chief ones being brick, clay, manganese, natural gas, glass-sand, and miscellaneous stone. Gold, platinum, and silver have been obtained by dredging in the Mokelumne River, which forms the boundary between this county and Amador on the northeast.

In twenty-ninth place, commercial production for 1924 was as follows:

Substance	Amount	Value
Brick	14,936 M	$462,688
Stone, miscellaneous		83,874
Other minerals*		55,938
Total value		$602,500

*Includes manganese ore and natural gas.

SAN LUIS OBISPO.

Area: 3334 square miles.
Population: 21,893 (1920 census).
Location: Bordered by Kern County on the east and the Pacific Ocean on the west.

The total value of the mineral production of San Luis Obispo County in 1924 was $317,779, as compared with the 1923 output, worth $145,249, the increase being due to miscellaneous stone and sodium sulphate. Among its mineral resources, both developed and undeveloped, are asphalt, bituminous rock, brick, chromite, coal, copper, diatomaceous earth, gypsum, iron, limestone, marble, mineral water, onyx, petroleum, quicksilver, soda, and miscellaneous stone.

In thirty-eighth place, commercial production for 1924 was as follows:

Substance	Amount	Value
Brick	2,033 M	$35,987
Petroleum	31,222 bbls.	30,972
Stone, miscellaneous		113,384
Other minerals*		137,436
Total value		$317,779

*Includes mineral water, natural gas, quicksilver, sodium sulphate.

SAN MATEO.

Area: 447 square miles.
Population: 36,781 (1920 census).
Location: Peninsula, adjoined by San Francisco on the north.

San Mateo's most important mineral products are stone and salt, the last-named being derived by evaporation from the waters of San Francisco Bay. The total value of all mineral production during 1924 equaled $302,171, as compared with the 1923 figures of $329,816, the decrease being due to stone.

Small amounts of barytes, chromite, infusorial earth, and quicksilver have been noted in addition to the items of economic value given below.

Bricks have also been produced commercially.

In thirty-ninth place, commercial production for 1924 was as follows:

Substance	Amount	Value
Salt	54,258 tons	$205,176
Stone, miscellaneous		75,078
Other minerals*		21,917
Total value		$302,171

*Includes gems, magnesium chloride, petroleum, potash.

SANTA BARBARA.

Area: 2740 square miles.
Population: 41,097 (1920 census).
Location: Southwestern portion of state, adjoining San Luis Obispo on the south.

Santa Barbara County owes its position of eighth in the state in regard to its mineral output to the presence of productive oil fields within its boundaries. The total value of its mineral production during

the year 1924 was $5,159,740, as compared with the 1923 output of $5,005,872, and included ten different mineral substances.

Aside from the mineral substances listed below, Santa Barbara County contains asphalt, diatomaceous earth, gilsonite, gypsum, magnesite, and quicksilver in more or less abundance.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Clay and clay products		$2,020
Natural gas	1,643,355 M cu. ft.	158,836
Petroleum	2,905,181 bbls.	3,009,768
Stone, miscellaneous		75,305
Other minerals*		1,913,811
Total value		$5,159,740

*Includes bituminous rock, diatomaceous earth, mineral water, shale oil.

SANTA CLARA.

Area: 1328 square miles.
Population: 100,588 (1920 census).
Location: West-central portion of state.

Santa Clara County reported a mineral output for 1924 of $1,150,401, as compared with the 1923 figures of $1,320,393.

This county, lying largely in the Coast Range Mountains, contains a wide variety of mineral substances, including brick, chromite, clay, limestone, magnesite, manganese, mineral water, petroleum, quicksilver, soapstone, and miscellaneous stone.

In twenty-second place, commercial production for 1924 was as follows:

Substance	Amount	Value
Brick	24,271 M	$217,172
Clay (pottery)	5,341 tons	5,666
Petroleum	14,417 bbls.	20,481
Stone, miscellaneous		259,023
Other minerals*		648,059
Total value		$1,150,401

*Includes limestone, magnesite, mineral water, natural gas, quicksilver.

SANTA CRUZ.

Area: 435 square miles.
Population: 26,269 (1920 census).
Location: Bordering Pacific Ocean, just south of San Mateo County.

The mineral output of Santa Cruz County, a portion of which is itemized below, amounted to a total value of $4,339,233, giving the county a standing of tenth among all others in the state in this regard. The increase over the 1923 figure of $4,225,905 is due to cement.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Lime	12,783 tons	$212,540
Stone, miscellaneous		29,217
Other minerals*		4,097,476
Total value		$4,339,233

*Includes bituminous rock, cement, limestone, potash.

SHASTA.

Area: 3858 square miles.
Population: 13,311 (1920 census).
Location: North-central portion of state.

Shasta County stood ninth in California among the mineral producing counties for 1924, with an output valued at $4,754,664, as compared with the 1923 production worth $1,563,387, the increase being due to copper.

The marked decrease in 1918–1921 was due to the falling off in the output of copper, the large plants of the Mammoth and Mountain copper companies being shut down. Not taking petroleum into account, Shasta for a number of years led all of the counties by a wide margin; but in 1919–1923 was passed by San Bernardino, Plumas, Yuba, Inyo, Sacramento, Nevada, and Amador, among the 'metal' counties, though by only San Bernardino of that group in 1924.

Shasta's mineral resources include asbestos, barytes, brick, chromite, coal, copper, gold, iron, lead, lime, limestone, mineral water, molybdenum, pyrite, silver, soapstone, miscellaneous stone, and zinc.

Lassen Peak is located in southeastern Shasta County.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Copper	21,109,958 lbs.	$2,765,405
Gold		346,622
Lead	6,615 lbs.	529
Limestone	28,097 tons	36,480
Platinum	27 fine oz.	3,361
Silver		343,402
Stone, miscellaneous		587,637
Other minerals*		671,228
Total value		$4,754,664

*Includes asbestos, coal, diatomaceous earth, iron ore, pyrites, zinc.

SIERRA.

Area: 923 square miles.
Population: 1783 (1920 census).
Location: Eastern border of state, just north of Nevada County.

Sierra County reported a mineral production of $812,476, mainly of gold and silver, during the year 1924, as compared with the 1923 output, worth $886,610, the decrease being due to gold. Considering gold output alone this county stands sixth; and as to total mineral yield twenty-fifth.

Aside from the metals itemized below, Sierra County contains deposits of asbestos, chromite, copper, iron, lead, platinum, serpentine, and talc.

Commercial production for 1924 was as follows:

Substance	Value
Gold	$799,276
Silver	5,198
Stone, miscellaneous	8,000
Other minerals	2
Total value	$812,476

SISKIYOU.

Area: 6256 square miles.
Population: 18,545 (1920 census).
Location: Extreme north-central portion of state, next to Oregon boundary.

Siskiyou, fifth county in California in regard to size, located in a

highly mineralized and mountainous country, ranks forty-fourth in regard to the value of its mineral output for 1924.

Although this county is traversed by a transcontinental railroad in a north and south line, the mineral bearing sections are almost without exception far from transportation and other facilities. A large part of the county is accessible by trail only. Future development and exploitation will increase the productiveness of this part of the state to a considerable degree.

Mount Shasta is located in Siskiyou County.

Among Siskiyou's mineral resources are chromite, clay, coal, copper, gems, gold, lead, limestone, manganese, marble, mineral water, pumice, quicksilver, sandstone, silver, and miscellaneous stone.

Commercial production for 1924 was as follows:

Substance	Value
Gold	$63,570
Mineral water	6,100
Silver	296
Stone, miscellaneous	67,787
Other minerals*	3,034
Total value	$140,787

*Includes coal, limestone, lime, platinum.

SOLANO.

Area: 822 square miles.

Population: 40,602 (1920 census).

Location: Touching San Francisco Bay on the northeast.

Solano, while mostly valley land, produced mineral substances during the year 1924 to the total value of $3,089,475, ranking twelfth among the counties of the state, the decrease from the 1923 figures of $3,376,885 being due to cement.

Among her mineral resources are brick, cement, clay, fuller's earth, limestone, mineral water, natural gas, onyx, quicksilver, salt, and miscellaneous stone.

Commercial production for 1924 was as follows:

Substance	Value
Stone, miscellaneous	$117,475
Other minerals*	2,972,000
Total value	$3,089,475

*Includes cement, mineral water, onyx.

SONOMA.

Area: 1577 square miles:

Population: 51,990 (1920 census).

Location: South of Mendocino County, bordering on the Pacific Ocean.

Sonoma ranked forty-second among the counties of California during the year 1924, with a mineral production of $172,051, as compared with its 1923 output of $227,312. More paving blocks have been turned out here than in any other section of the state, but this industry has now practically ceased, owing to the construction of smooth-surface pavements both in the cities and on the highways.

Among Sonoma's mineral resources are brick, chromite, clay, copper, graphite, infusorial earth, magnesite, manganese, marble, mineral paint, mineral water, quicksilver, and miscellaneous stone.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Mineral water	31,003 gals.	$8,002
Quicksilver	867 flasks	60,840
Stone, miscellaneous		101,009
Other minerals		2,200
Total value		$172,051

STANISLAUS.

Area: 1450 square miles.
Population: 43,557 (1920 census).
Location: Center of state, bounded on south by Merced County.

Gold has usually been the chief mineral product of Stanislaus County, but it was exceeded in 1918–1919 by manganese, and in 1921–1923 by miscellaneous stone. Brick, clay, gypsum, mineral paint, quicksilver, and silver are found here to some extent as well. This county for 1924 ranks thirty-seventh in the state in regard to value of minerals, with an output of $345,138, as compared with $445,515 in 1923, the decrease being due to magnesite and miscellaneous stone, though there was an increase in gold yield. Gold, platinum, and silver are obtained mainly by dredging.

Commercial production for 1924 was as follows:

Substance	Value
Gold	$196,019
Silver	773
Stone, miscellaneous	118,050
Other minerals*	30,296
Total value	$345,138

*Includes magnesite, manganese ore, mineral paint, platinum.

SUTTER.

Area: 608 square miles.
Population: 10,115 (1920 census).
Location: Bounded by Butte County on the north and Sacramento on the south.

Sutter is one of only two counties in the state which for a number of years reported no commercial output of some kind of mineral substance. In 1917 some crushed rock was taken out, from the Marysville Buttes, but there was no production in 1918–1919. There has been some utilization of natural gas. The 1924 mineral yield was valued at $97, being concealed under 'unapportioned.' Both clay and coal exist here, but deposits of neither mineral have been placed on a productive basis.

TEHAMA.

Area: 2893 square miles.
Population: 12,882 (1920 census).
Location: North-central portion of the state, bounded on the north by Shasta.

Tehama stands fifty-third among the mineral producing counties of the state for 1924 when its output was valued at $34,454, as compared with the 1923 yield worth $6,216, the increase being due to stone.

Among its mineral resources are listed brick, chromite, copper, gold, manganese, marble, mineral water, salt, and miscellaneous stone.

The 1924 yield was distributed as follows:

Substance	Value
Stone, miscellaneous	$26,054
Other minerals*	8,400
Total value	$34,454

*Includes brick and chromite.

TRINITY.

Area: 3166 square miles.
Population: 2551 (1920 census).
Location: Northwestern portion of state.

Trinity, like its neighbor, Siskiyou County, requires transportation facilities to further the development of its many and varied mineral resources. Deposits of asbestos, barytes, chromite, copper, gold, mineral water, platinum, quicksilver, silver, and building stone are known here, but with the exception of gold, chromite, copper, quicksilver, and platinum, very little active production of these mineral substances has been made as yet. The 1924 output of $509,344 shows a decrease from the 1923 figure of $677,174, due to gold, giving the county rank of thirty-first for the year.

Substance	Amount	Value
Copper	550,000 lbs.	$72,050
Gold		422,281
Platinum	11 fine oz.	1,839
Silver		10,934
Stone, miscellaneous		2,240
Total value		$509,344

TULARE.

Area: 4856 square miles.
Population: 59,031 (1920 census).
Location: Bounded by Inyo on the east, Kern on the south, Fresno on the north.

Tulare stands thirty-second on the list of mineral producing counties. the increase over the 1923 value being due mainly to miscellaneous stone. This county's mineral resources, among others, are brick, clay, copper, feldspar, graphite, gems, limestone, magnesite, marble, quartz, glass-sand, soapstone, miscellaneous stone, and zinc. Tulare for a number of years led the state in magnesite output, except in 1918 when it was passed by Napa County, and in 1921–1924 by Santa Clara.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Magnesite	21,203 tons	$271,830
Natural gas	1,080 M cu. ft.	540
Stone, miscellaneous		80,411
Other minerals*		145,893
Total value		$498,674

*Includes brick and hollow tile, granite, limestone.

TUOLUMNE.

Area: 2190 square miles.
Population: 7768 (1920 census).
Location: East-central portion of state—Mother Lode District.

Tuolumne ranks twenty-eighth among counties of the state relative to its total value of mineral output for 1924. This county ranks first as a producer of marble in the state. The decrease in the year's valuation to $629,156 for 1924 from the 1923 figure of $670,362 was due to gold, lime, and marble.

Chromite, clay, copper, gold, lead, limestone, marble, mineral paint, platinum, soapstone, silver, and miscellaneous stone are among its mineral resources.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Gold		$255,994
Limestone	8,515 tons	19,983
Silver		1,106
Stone, miscellaneous		12,500
Other minerals*		339,573
Total value		$629,156

*Includes clay, dolomite, granite, lime, marble.

VENTURA.

Area: 1878 square miles.
Population: 28,724 (1920 census).
Location: Southwestern portion of state, bordering on Pacific Ocean.

Ventura is the sixth county in the state in respect to the value of its mineral production for 1924, the exact figure being $6,089,394, as compared with the output for 1923, worth $4,679,684, the increase being due to higher petroleum prices.

The highest gravity petroleum produced in the state is found here.

Among its other mineral resources are asphalt, borax, brick, clay, mineral water, natural gas, sandstone, and miscellaneous stone.

Commercial production for 1924 was as follows:

Substance	Amount	Value
Natural gas	5,995,760 M cu. ft.	$633,352
Petroleum	3,958,010 bbls.	5,279,985
Stone, miscellaneous		173,337
Other minerals*		2,720
Total value		$6,089,394

*Includes limestone and sandstone.

YOLO.

Area: 1014 square miles.
Population: 17,105 (1920 census).
Location: Sacramento Valley, bounded by Sutter on the east and Colusa on the north.

The mineral production from Yolo County during the year 1924 consisted mainly of miscellaneous stone, valued at $15,800, ranking it in fifty-fourth place. Deposits of undetermined value of iron and sandstone have been discovered within the confines of this county. Quicksilver has also been produced.

YUBA.

Area: 639 square miles.
Population: 10,375 (1920 census).
Location: Lies west of Sierra and Nevada counties; south of Plumas.

Yuba is eighteenth of the mineral producing counties of the state, and third in regard to gold output for 1924, being passed by Nevada and Amador counties in that metal. Iron and clay deposits have been reported in this county aside from the following commercial production shown for the year 1924. The decrease from the 1923 figure of $3,391,129 was due mainly to gold obtained by the dredgers, which also yield silver and platinum, and also due in part to sand. The 1921 dredge yield of gold was a record for the county.

The 1924 production of Yuba County was distributed as follows:

Substance	Amount	Value
Gold		$1,995,434
Platinum	73 fine oz.	8,773
Stone, miscellaneous		4,461
Other minerals		181,113
		100
Total value		$2,190,181

APPENDIX.

MINING BUREAU ACT.

Chapter 679.

[Stats. 1913.]

An act establishing a state mining bureau, creating the office of state mineralogist, fixing his salary and prescribing his powers and duties; providing for the employment of officers and employees of said bureau, making it the duty of persons in charge of mines, mining operations and quarries to make certain reports, providing for the investigation of mining operations, dealings and transactions and the prosecution for defrauding, swindling and cheating therein, creating a state mining bureau fund for the purpose of carrying out the provisions of this act and repealing an act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all acts amendatory thereof and supplemental thereto or in conflict herewith.

[Approved June 16, 1913. In effect August 10, 1913.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby created and established a state mining bureau. The chief officer of such bureau shall be the state mineralogist, which office is hereby created.

SEC. 2. It shall be the duty of the governor of the State of California and he is hereby empowered to appoint a citizen and resident of this state, having a practical and scientific knowledge of mining, to the office of state mineralogist. Said state mineralogist shall hold his office at the pleasure of the governor. He shall be a civil executive officer. He shall take and subscribe the same oath of office as other state officers. He shall receive for his services a salary of three hundred dollars ($300) per month, to be paid at the same time and in the same manner as the salaries of other state officers. He shall also receive his necessary traveling expenses when traveling on the business of his office. He shall give bond for the faithful performance of his duties in the sum of ten thousand dollars ($10,000), said bond to be approved by the governor of the State of California.

SEC. 3. Said state mineralogist shall employ competent geologists, field assistants, qualified specialists and office employees when necessary in the execution of his plans and operations of the bureau, and fix their compensation. The said employees shall be allowed their necessary traveling expenses when traveling on the business of said department and shall hold office at the pleasure of said state mineralogist.

SEC. 4. It shall be the duty of said state mineralogist to make, facilitate, and encourage, special studies of the mineral resources and mineral industries of the state. It shall be his duty: to collect statistics concerning the occurrence and production of the economically important minerals and the methods pursued in making their valuable constituents available for commercial use; to make a collection of typical geological and mineralogical specimens, especially those of economic and commercial importance, such collection constituting the museum of the state mining bureau: to provide a library of books, reports, drawings, bearing upon the mineral industries, and sciences of mineralogy and geology, and arts of mining and metallurgy, such library constituting the library of the state mining bureau; to make a collection of models, drawings and descriptions of the mechanical appliances used in mining and metallurgical processes; to preserve and so maintain such collections and library as to make them available for reference and examination, and open to public inspection at reasonable hours; to maintain, in effect, a bureau of information concerning the mineral industries of this state, to consist of such collections and library, and to arrange, classify, catalogue, and index the data therein contained, in a manner to make the information available to those desiring it; to issue from time

to time such bulletins as he may deem advisable concerning the statistics and technology of the mineral industries of this state.

SEC. 5. It is hereby made the duty of the owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character, within the state, to forward to the state mineralogist, upon his request, at his office not later than the thirtieth day of June, in each year, a detailed report upon forms which will be furnished showing the character of the mine, the number of men then employed, the method of working such mine and the general condition thereof, the total mineral production for the past year, and such owner, lessor, lessee, agent, manager or other person in charge of any mine within the state must furnish whatever information relative to such mine as the state mineralogist may from time to time require for the proper discharge of his official duties. Any owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character within the state, who fails to comply with the above provisions shall be deemed guilty of a misdemeanor.*

SEC. 6. The state mineralogist now performing the duties of the office of state mineralogist shall perform the duties of the office of state mineralogist as in this act provided until the appointment and qualification of his successor as in this act provided.

SEC. 7. The said state mineralogist shall take possession, charge and control of the offices now occupied and used by the board of trustees and state mineralogist and the museum, library and laboratory of the mining bureau located in San Francisco as provided for by a certain act of the legislature approved March 23, 1893, and hereafter referred to in section fourteen hereof, and shall maintain such offices, museum, library and laboratory for the purposes provided in this act.

SEC. 8. Said state mineralogist or qualified assistant shall have full power and authority at any time to enter or examine any and all mines, quarries, wells, mills, reduction works, refining works and other mineral properties or working plants in this state in order to gather data to comply with the provisions of this act.

SEC. 9. The state mineralogist shall make a biennial report to the governor on or before the fifteenth day of September next preceding the regular session of the legislature.

SEC. 10. All moneys received by the state mining bureau or any officer thereof (except such as may be paid to them by the state for disbursement) shall be receipted for by the state mineralogist or other officer authorized by him to act in his place and at least once a month accounted for by him to the state controller and paid into the state treasury to the credit of a fund which is hereby created and designated "state mining bureau fund." All moneys now in the possession of the state mining bureau or any officer thereof received from any source whatsoever, shall be immediately paid over to the state mineralogist and by him accounted for to the controller and paid into the state treasury to the credit of said fund. Said fund shall be used and is hereby appropriated for the use of said bureau in carrying out the purposes of this act.

SEC. 11. The said state mineralogist is hereby authorized and empowered to receive on behalf of this state, for the use and benefit of the state mining bureau, gifts, bequests, devises and legacies of real or other property and to use the same in accordance with the wishes of the donors, and if no instructions are given by said donors, to manage, use, and dispose of the gifts and bequests and legacies for the best interests of said state mining bureau and in such manner as he may deem proper.

SEC. 12. The state mineralogist may, whenever he deems it advisable, prepare a special collection of ores and minerals of California to be sent to or used at any world's fair or exposition in order to display the mineral wealth of the state.

SEC. 13. The state mineralogist is hereby empowered to fix a price upon and to dispose of to the public, at such price, any and all publications of the state mining bureau, including reports, bulletins, maps, registers or other publications, such price shall approximate the cost of publication and distribution. Any and all sums derived from such disposition, or from gifts or bequests made, as hereinbefore provided must be accounted for by said state mineralogist and turned over to the state treasurer to be credited to the mining bureau fund as provided for in section

*Sec. 19 of the Penal Code of California provides: "Except in cases where a different punishment is prescribed by this code, every offense declared to be a misdemeanor is punishable by imprisonment in a county jail not exceeding six months, or by a fine not exceeding five hundred dollars, or by both."

ten. He is also empowered to furnish without cost to public libraries the publications of the bureau and to exchange publications with other geological surveys and scientific societies, etc.

SEC. 14. The state mineralogist provided for by this act shall be the successor in interest of the board of trustees of the state mining bureau, and the state mineralogist, under and by virtue of that certain act, entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management, and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all books, papers, documents, personal property, records, and property of every kind and description obtained or possessed, or held or controlled by the said board of trustees of the said state mining bureau, and the state mineralogist, and the clerks and employees thereof, under the provisions of said act of March 23, 1893, or any act supplemental thereto or amendatory thereof, shall immediately be turned over and delivered to the said state mineralogist herein provided for, who shall have charge and control thereof.

SEC. 15. That certain act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, and to provide for the appointment, duties and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction, and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, together with all acts amendatory thereof and supplemental thereto and all acts in conflict herewith are hereby repealed.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; Sun Finance Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
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**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
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**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
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**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
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These maps are revised from time to time as development work advances and ownerships change.

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Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
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Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
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Map No. 31—Inglewood, Los Angeles County	.75

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LLOYD L. ROOT,
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